# WORK AND SAMPLING PLAN

## BAYONNE BARREL AND DRUM SITE

## BAYONNE, NEW JERSEY

Prepared for:

U.S. Environmental Protection Agency
Region II - Removal Action Branch
Edison, New Jersey

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## 1.0 SITE BACKGROUND

The Bayonne Barrel and Drum Site is a former drum reconditioning facility occupying approximately 15 acres off Raymond Boulevard in the Ironbound section of Newark, New Jersey (See Attachment A). The facility operated as an unlicensed treatment, storage and disposal (TSD) facility from the early 1940's until the early 1980's when the company filed for bankruptcy. The site is bordered to the North and West by Routes 1 and 9, to the East by the New Jersey Turnpike and the South by the Newark Multiplex Cinema.

At the time the facility was operating, drum cleaning operations involved both closed-head and open-head drums. In closed head drum cleaning, chains and caustic solution were used to wash out previous material in the drums. The spent solution drained through an oil-water separator into a 5,000-gallon underground holding/settling tank and was then pumped into a 60,000-gallon aboveground holding/settling tank. The liquid was decanted to the sewer under a permit from the Passaic Valley Sewage Commission. Open-head drums were placed on a conveyer and moved through the furnace/incinerator, which burned materials inside the drums. Residue materials were collected in two subsurface holding/settling tanks adjacent to the incinerator.

The operation produced a large amount of spent cleaning solutions, furnace ash and sludges. Approximately 40,000 pounds of incinerator ash and sludge were reportedly generated monthly. The storage of these wastes, as well as the storage of drums awaiting reconditioning, are believed to have been the chief source of site contamination.

## 2.0 DATA USE OBJECTIVES

The objective of this sampling event is to determine if significant groundwater contamination exists at the site. The samples will be collected by U.S. EPA and START and submitted to a private laboratory for analysis. The analytical data will be used to:

I. Establish the presence and concentration of groundwater contaminants;

II. Determine whether these materials pose a threat to human health and/or the environment. Contaminant concentrations will be compared to the New Jersey Groundwater Quality Standards (N.J.A.C. 7:9-6), which are listed in Attachment H.

III. Determine groundwater flow direction and tidal influence;

IV. Establish data necessary for classifying the site as a Classification Exemption Area (CEA) with the New Jersey Department of Environmental Protection .

## 3.0 QUALITY ASSURANCE OBJECTIVES

The EPA On-Scene Coordinator (OSC) has specified a Level 2 QA objective (QA-2). Details of this QA level are provided in Section 6.0.

As identified in Section 2.0, the objective of this proposal/event applies to the following parameters:

**TABLE 1**
**QUALITY ASSURANCE OBJECTIVES**

| QA Parameters | Matrix | Intended Use of Data | QA Objective |
|---|---|---|---|
| TCL Volatiles, Extractables, Pesticides, PCBs | Aqueous | Establish the presence and concentration of groundwater contaminants | QA-2 |
| TAL Metals | " | " | " |
| Ammonia, Color, Fluoride, Hardness, Nitrate, Nitrite, Odor, Oil & Grease, TPH, TDS, Foaming Agents | " | " | " |
| TCL Volatiles, Extractables, Pesticides, PCBS | LNAPL | Establish the presence and concentration of groundwater contaminants | QA-2 |
| TAL Metals | " | " | " |
| Oil & Grease, TPH | " | " | " |

A Field Sampling Summary follows in Table 2. Section 4.2 (Sampling Design) provides information on analyses to be performed on the individual water samples.

# TABLE 2
# ANALYTICAL PARAMETERS FOR QA/QC SAMPLES

| Analytical Parameter | Matrix | Container Type & Volume | Preservative | Holding Time | Subtotal Samples | Duplicate | Matrix Spikes | Rinsate Blank | Trip Blank | Total Samples |
|---|---|---|---|---|---|---|---|---|---|---|
| TAL Metals | Aqueous | 1 X 1L Poly | $HNO_3$ to ph<2, 4 °C | 180 Days (Hg - 28 days) | 11 | one | one | three | none | 16 |
| TCL Volatiles | Aqueous | 3 X 40mL Vials | HCL to ph<2, 4 °C | 14 Days | 11 | one | one | three | one/ shipment | 16 |
| TCL Extractibles | Aqueous | 4 X 1L Amber | 4 °C | 14 Days / 7 Days if not preserved | 11 | one | one | three | none | 16 |
| Ammonia | Aqueous | 1 X 4oz. Poly | $H_2SO_4$ to ph<2, 4 °C | 28 Days | 11 | one | N/A | three | none | 16 |
| Color | Aqueous | 1 X 4oz. Poly | 4 °C | 48 Hours | 11 | one | N/A | three | none | 16 |
| Fluoride | Aqueous | 1 X 4oz. Poly | 4 °C | 28 Days | 11 | one | N/A | three | none | 16 |
| Hardness | Aqueous | 1 X 4oz. Poly | 4 °C | 6 months | 11 | one | N/A | three | none | 16 |
| Nitrate | Aqueous | 1 X 4oz. Plastic | $H_2SO_4$ to ph<2, 4 °C | 48 Hours | 11 | one | N/A | three | none | 16 |
| Nitrite | Aqueous | (In with Nitrate) | $H_2SO_4$ to ph<2, 4 °C | 48 Hours | 11 | one | N/A | three | none | 16 |
| Odor | Aqueous | 1 X 4oz. Glass | 4 °C | 48 Hours | 11 | one | N/A | three | none | 16 |
| Oil & Grease | Aqueous/ | 1 X 1L Amber | $H_2SO_4$ to ph<2, 4 °C | 28 Days | 11 | one | N/A | three | none | 16 |
| TPH | Aqueous | 1 X 1L Amber | HCL to ph<2, 4 °C | 14 Days | 11 | one | N/A | three | none | 16 |
| TDS | Aqueous | 1 X 1L Poly | 4 °C | 7 Days | 11 | one | N/A | three | none | 16 |
| TAL Metals | LNAPL | 1 X 4 oz. Glass | 4 °C | 180 Days (Hg - 28 days) | 1 | one | one | N/A | none | 3 |
| TCL Volatiles & Extractibles | LNAPL | 2 X 4oz. Glass, 1 X 8oz. Glass | 4 °C | 14 Days | 1 | one | one | N/A | none | 3 |
| Oil & Grease | LNAPL | 1 X 4oz. Glass | 4 °C | 28 Days | 1 | one | N/A | N/A | none | 3 |
| TPH | LNAPL | 1 X 4oz. Glass | 4 °C | 14 Days | 1 | one | N/A | N/A | none | 3 |

# TABLE 3
## QA/QC ANALYSIS AND OBJECTIVES

| QA Parameters | Matrix | Intended Use of Data | Analytical Method Reference | QA/QC Quantitation Limits | QA Objective |
|---|---|---|---|---|---|
| TAL Metals | Aqueous/ LNAPL | Establish the presence and concentrations of contaminants | CLP SOW ILMO 4.0(or most recent method) | As Per Method | QA-2 |
| TCL Organics | Aqueous/ LNAPL | Establish the presence and concentrations of contaminants | CLP SOW OLMO 3.2(or most recent method) | As Per Method | QA-2 |
| Ammonia | Aqueous | Establish the presence and concentrations of contaminants | MCAW Method 350.1 | As Per Method | QA-2 |
| Color | Aqueous | Establish the presence and concentrations of contaminants | MCAW Method 110.3 | As Per Method | QA-2 |
| Fluoride | Aqueous | Establish the presence and concentrations of contaminants | MCAW Method 340.3 | As Per Method | QA-2 |
| Hardness | Aqueous | Establish the presence and concentrations of contaminants | MCAW Method 130.1 | As Per Method | QA-2 |
| Nitrate | Aqueous | Establish the presence and concentrations of contaminants | MCAW Method 352.1 | As Per Method | QA-2 |
| Nitrite | Aqueous | Establish the presence and concentrations of contaminants | MCAW Method 354.1 | As Per Method | QA-2 |
| Odor | Aqueous | Establish the presence and concentrations of contaminants | MCAW Method 140.1 | As Per Method | QA-2 |
| Oil & Grease | Aqueous/ LNAPL | Establish the presence and concentrations of contaminants | MCAW Method 413.2 | As Per Method | QA-2 |
| TPH | Aqueous/ LNAPL | Establish the presence and concentration of contaminants | MCAW Method 418.1 | As Per Method | QA-2 |
| Total Dissolved Solids (TDS) | Aqueous | Establish the presence and concentrations of contaminants | MCAW Method 160.1 | As Per Method | QA-2 |

## 4.0 APPROACH AND SAMPLING METHODOLOGIES

### 4.1 Sampling Equipment

Groundwater samples will be collected using stainless steel Grundfos Redi-flo 2 submersible pumps with Teflon® lined disposable polyethylene tubing for up to 11 wells which are located throughout the Bayonne Barrel and Drum Site. The sampling procedure is specified in Section 4.2 and in Attachment B (Groundwater Well Sampling SOP # 2007) and Attachment C (Low-Stress Purging and Sampling SOP). Monitoring well 2614909-5, which contains a light non-aqueous phase liquid (LNAPL) will be sampled for LNAPL using a teflon bailer. All non-dedicated sampling equipment and materials will be decontaminated according to the Sampling Equipment Decontamination SOP # 2006 (Attachment E).

### 4.2 Sampling Design

#### 4.2.1 Monitoring Well Repair / Replacement

Two of the monitoring wells located on site are too damaged for sampling and require repair and/or replacement. The monitoring wells are identified as 29W and BBD-C4. START, in a formal Request For Proposal (RFP) will subcontract out the drilling operations for the repair of the two wells.

#### 4.2.2 Monitoring Well Surveying

Review of the historic literature and recent visits to the site have shown that the monitoring wells have not been surveyed. Since the site slopes topographically and water level data is being collected, it is important for groundwater flow determination purposes that the twelve wells be surveyed prior to sampling. This sampling event includes the sampling of eleven of these wells. Monitoring well BBD-C2, which was recently discovered collapsed, will not be sampled during this event. However, the surveying of this well will become important for past data referencing.

#### 4.2.3 Monitoring Well Redevelopment

None of the wells at the Bayonne Barrel and Drum Site have been sampled in the last 10 years, therefore re-development of these wells will be necessary. The well development procedures are specified in Attachment D (Well Development SOP # 2156). A maximum of 12 groundwater wells will require re-development. Attachment G represents the summary of groundwater elevation, screen/riser type, and well screen elevations. The well locations are identified in Attachment A.

The following procedure will be used for groundwater well development:

1. Wear appropriate Personal Protective Equipment (PPE) as outlined in the site specific Health and Safety Plan. In addition, developers will use new sampling gloves at each

individual well prior to development.

2. Record pertinent information in the field logbook (see Section 4.3.1)

3. Unlock well cap and open the monitoring well.

4. Monitor volatile organic vapor levels at the top of casing and in the breathing zone with a photoionization device (HNu or Microtip) or flame ionization detector (OVA) and record results in the field logbook.

5. Measure the static water level in the well with an electronic water level indicator, as well as, the total depth of the monitoring well from the same datum point. The water level indicator will be decontaminated following the procedures outlined in the Sampling Equipment Decontamination SOP #2006 (Attachment).

6. Measure the initial pH, temperature and specific conductivity of the water and record in the field logbook.

7. Develop the well following the overpumping method using a submersible pump until the water is clear and appears to be free of sediment. Overpumping involves pumping at a rate rapid enough to draw the water level in the well as low as possible, and allowing it to recharge. Note the initial color, clarity and odor of the water.

8. All of the water produced by monitoring well development, sampling, and equipment decontamination will be allowed to percolate back down to the water table in a manner that will not allow for runoff from the site.

9. Measure the final pH, temperature and specific conductivity of the water and record in the field logbook. Note the final color, clarity and odor of the water. Record the final static water level.

10. Record the following data in the field logbook:

    ·Well designation (location ID)
    ·Date(s) of well installation
    ·Date(s) and time of well development
    ·Static water level before and after
    ·Quantity of water removed and time of removal
    ·Type and size/capacity of pump and/or bailer used
    ·Description of well development techniques used

11. Decontaminate equipment.

12. Re-lock well cap.

### 4.2.4 Groundwater Sampling

A maximum of 11 aqueous samples will be collected and analyzed for TCL Volatiles, TAL Metals, Total Petroleum Hydrocarbons (TPH), Oil & Grease, Ammonia, Color, Fluoride, Hardness, Nitrate, Nitrite, Odor, and Total Dissolved Solids (TDS). Attachment G represents the well construction details for six of the wells to be sampled (Information on the other wells is not available). The well location plan is located in Attachment A. Sampling procedures may be initiated only after the wells have been properly redeveloped. The OSC has specified that the there must be at least a one week waiting period between monitoring well redevelopment and sampling. The Low-Stress Purging and Sampling SOP (EPA) and the Groundwater Well Sampling SOP (EPA/ERT #2007) are included as attachments to this sampling plan.

The following procedure will be used for groundwater well sampling:

1. Wear appropriate Personal Protective Equipment (PPE) as outlined in the site specific Health and Safety Plan. In addition, samplers will use new sampling gloves at each individual well prior to sampling.

2. Visually examine the exterior of the monitoring well prior to sampling.

3. Unlock well cap.

4. Monitor volatile organic vapor levels at the well head with a photoionization device (HNu or Microtip) or a flame ionization detector (OVA) and record results in logbook.

5. Measure the static water level in the well with an electronic water level indicator. The water level indicator will be decontaminated following the procedures outlined in the Sampling Equipment Decontamination SOP #2006 (Attachment).

6. Calculate the volume of water in the well (V) as follows:

$$V = \pi r^2 h \text{ (cf)}$$

Where:

$\pi$ = 3.14
r = radius of monitoring well (feet)
h = height of water column (feet)
cf = 7.48 conversion factor (gal/ft$^3$)

For a 2-inch diameter well, the volume in gallons is equal to:

Well volume = 0.163 X height of water column (feet)

For a 4-inch diameter well, the volume in gallons is equal to:

Well volume = 0.6528 X height of water column (feet)

7. Lower the intake line through the well to just above screen depth ensuring that all stagnant water in the well has been purged. Measure the new water level.

8. Purge the well with a stainless steel submersible pump (starting rate between 200 and 500 ml/min.) equipped with a check valve to avoid backflush and Teflon® lined polyethylene tubing dedicated to each well. The well purging should continue until the indicator parameters, measured with a Horiba U-10® Water Quality Meter have stabilized for three successive readings. Indicator parameters to be measured include pH, temperature, dissolved oxygen, turbidity and oxidation reduction potential. Indicator parameter measurements and water levels should be checked every 5-10 minutes. Water level drawdown should not exceed 0.3 feet.

9. Place polyethylene sheeting around well casing as applicable to prevent contamination of sampling equipment.

10. Obtain the sample at the outlet of the pumps at the same flow rate at which stabilization occurred except for the collection of VOAs. Sampling flow rate for VOAs will be at about 100 ml/min.

11. The preservation procedure shall be:

    a) VOAs - In a separate 40 ml glass vial determine the amount of 1:1 HCl preservative required to adjust the pH of the sample to less than 2. Add this volume to the empty 40 ml vials prior to sampling. Fill each container with sample to just overflowing so that no air bubbles are entrapped inside. If effervescence occurs submit without preservative and note on the respective Traffic Report.

    b) Other parameters - Fill each container and preserve immediately as specified in Table 2. To test for pH, pour a minimum portion of sample onto broad range pH paper to verify that the appropriate pH level has been obtained.

12. Place analytical samples in Ziplock bags and then in coolers and chill to 4°C. Samples will be shipped to the appropriate laboratory within as soon as possible.

13. Decontaminate equipment.

14. Re-lock well cap.

15. Fill out field notebook, sample log sheet, labels, custody seals and Chain of Custody forms.

### 4.2.5 LNAPL Sampling

One LNAPL sample will be collected and analyzed for TCL Volatiles, TAL Metals, Total Petroleum Hydrocarbons (TPH), and Oil & Grease. The well location plan is located in Attachment A. Sampling procedures may be initiated only after the well has been properly redeveloped. The OSC has specified that the there must be at least a one week waiting period between monitoring well redevelopment and sampling. The presence of LNAPL in the well, for safety reasons, will not allow for the sampling of the well with a pump. The well therefore be purged and sampled using teflon bailers.

The following procedure will be used for groundwater well sampling:

1. Wear appropriate Personal Protective Equipment (PPE) as outlined in the site specific Health and Safety Plan. In addition, samplers will use new sampling gloves at each individual well prior to sampling.

2. Visually examine the exterior of the monitoring well prior to sampling.

3. Unlock well cap.

4. Monitor volatile organic vapor levels at the well head with a photoionization device (HNu or Microtip) or a flame ionization detector (OVA) and record results in logbook.

5. Measure the static water level in the well with an electronic water level indicator. The water level indicator will be decontaminated following the procedures outlined in the Sampling Equipment Decontamination SOP #2006 (Attachment).

6. Calculate the volume of water in the well (V) as follows:

$$V = \pi r^2 h \text{ (cf)}$$

Where:

$\pi$ = 3.14
r = radius of monitoring well (feet)
h = height of water column (feet)
cf = 7.48 conversion factor ($gal/ft^3$)

For a 2-inch diameter well, the volume in gallons is equal to:

Well volume = 0.163 X height of water column (feet)

For a 4-inch diameter well, the volume in gallons is equal to:

Well volume = 0.6528 X height of water column (feet)

7. Lower the intake line through the well to just above screen depth ensuring that all stagnant water in the well has been purged. Measure the new water level.

8. Purge the well with a new, clean, teflon bailer. At least three to five volumes of the LNAPL in the well casing will be purged. Indicator parameters will not be measured due to the nature of the LNAPL.

9. Place polyethylene sheeting around well casing as applicable to prevent contamination of sampling equipment.

10. Obtain the sample using a new, clean, teflon bailer.

11. Due to the unknown nature of the LNAPL, sample preservation will not be employed.

12. Place analytical samples in Ziplock bags and then in coolers and chill to 4°C. Samples will be shipped to the appropriate laboratory within as soon as possible.

13. Dispose of equipment.

14. Re-lock well cap.

15. Fill out field notebook, sample log sheet, labels, custody seals and Chain of Custody forms.

### 4.2.6 Static Water Level Readings

The location of the site is such that its proximity to the Passaic River and Raritan Bay likely influences the static water levels of the monitoring wells (tidal influence). Therefore, static water level recorders operating over a 24 hour duration will be necessary. This should be accomplished immediately after the monitoring wells have been sampled.

This sampling design is based on information currently available and may be modified on site in light of other acquired information or at the discretion of the OSC. All deviations from the Sampling Plan will be noted in the Sampling Trip Report.

### 4.2.7 Equipment Decontamination

Equipment decontamination procedures are outlined in EPA/ERT SOP#2006 (Attachment E). Gross contamination of equipment requires physical decontamination by the use of brushes, soap/Alconox and water. This is followed by a:

-Tap water rinse
-Distilled water rinse
-10% nitric acid rinse
-Distilled water rinse

-Hexane rinse
-Air dry
-Wrap or cover exposed ends of the sampling equipment with aluminum foil (shiny side out) until next use, transport or handling.

One rinsate blank sample will be collected per sampling date if non-dedicated equipment is used. Only certified distilled, deionized blank water will be used in the collection of the rinsate blanks.

## 4.3 Standard Operating Procedures (SOPS)

### 4.3.1 Sample Documentation

The sample documents will be completed legibly, in ink. Any corrections or revisions will be made by lining through the incorrect entry and by initialing the error.

FIELD LOGBOOK

The field logbook is essentially a descriptive notebook detailing site activities and observations so that an accurate account of field procedures can be reconstructed in the writer's absence. All entries will be dated and signed by the individuals making the entries, and should include (at a minimum) the following:

1. Site name and project number.
2. Name(s) of personnel on site.
3. Dates and times of all entries (military time preferred).
4. Descriptions of all site activities, site entry and exit times.
5. Noteworthy events and discussions.
6. Weather conditions.
7. Site observations.
8. Sample and sample location identification and description*.
9. Subcontractor information and names of on-site personnel.
10. Date and time of sample collections, along with chain of custody information.
11. Record of photographs.
12. Site sketches.

* A well purging form (Attachment F) will be used to document the sample location and other information.

SAMPLE LABELS

Sample labels will clearly identify the particular sample, and should include the following:

1. Site/project number.
2. Sample identification number.
3. Sample collection date and time.
4. Designation of sample (grab or composite).
5. Sample preservation.
6. Analytical parameters.
7. Name of sampler.

Sample labels will be written in indelible ink and securely affixed to the sample container.

## CHAIN OF CUSTODY RECORD

A chain of custody record will be maintained from the time the sample is taken to its final deposition. Every transfer of custody must be noted and signed for, and a copy of this record kept by each individual who has signed. When samples (or groups of samples) are not under direct control of the individual responsible for them, they must be stored in a locked container sealed with a custody seal. Specific information regarding custody of the samples projected to be collected on the weekend will be noted in the field logbook.

A separate chain of custody form must accompany each cooler for each daily shipment. The chain of custody form must address all samples in that cooler, but not address samples in any other cooler. This practice maintains the chain of custody for all samples in case of mis-shipment.

The chain of custody record should include (at minimum) the following:

1. Sample identification number.
2. Sample information.
3. Sample location.
4. Sample date.
5. Name(s) and signature(s) of sampler(s).
6. Signature(s) of any individual(s) with control over samples.

## CUSTODY SEALS

Custody seals demonstrate that a sample container has not been tampered with, or opened. The individual in possession of the sample(s) will sign and date the seal, affixing it in such a manner that the container cannot be opened without breaking the seal. The name of this individual, along with a description of the sample packaging, will be noted in the field logbook.

### 4.3.2 Sampling SOPs

GROUNDWATER SAMPLING

Groundwater sampling activities will be conducted as specified in Section 4.2 and follow the guidelines outlined in EPA/ERT Groundwater Well Sampling SOP #2007 (Attachment B), the EPA Low-Stress Purging and Sampling SOP (Attachment C).

SAMPLING DECONTAMINATION

Sampling equipment decontamination procedures will follow the guidelined outlined in EPA/ERT Sampling Equipment Decontamination SOP #2006 (Attachment E).

### 4.3.3 Sample Handling and Shipment

Each of the sample bottles will be sealed and labeled according to the following protocol. Caps will be secured with custody seals. Bottle labels will contain all required information including site/project code and sample number, time and date of collection, analyses requested, and preservative used. Sealed bottles will be placed in large metal or plastic coolers, and padded with an absorbent material such as vermiculite. All packaging will conform to IATA Transportation regulations for overnight carriers.

All sample documents will be sealed in a plastic bag and affixed to the underside of each cooler lid. The lid will be sealed and affixed on at least two sides with custody seals so that any sign of tampering is easily visible.

## 4.4 Analytical Methods

Analytical methods to be utilized in the analyses of samples collected during this sampling event are detailed in Table 3.

## 4.5 Schedule of Activities

| Proposed Start Date | Activity | End Date |
|---|---|---|
| 9 November 1998 | Well Repair, Redevelopment, and Survey | 13 November 1998 |
| 30 November 1998 | Well Sampling | 4 December 1998 |

## 4.6 Disposal of PPE and Contaminated Sampling Materials

All used PPE and disposable sampling supplies will be bagged by START and secured on site for disposal during the removal.

## 5.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The EPA OSC, Joesph Cosentino (732-906-6983) will provide overall direction to the Region II START members concerning project sampling needs, objectives and schedule.

The Region II START PM, John Brennan (732-225-6116), is the primary point of contact with the OSC. The PM is responsible for the development and completion of the Sampling QA/QC Plan, project team organization and supervision of all project tasks, including reporting and deliverables. The site QC coordinator will be responsible for ensuring field adherence to the Sampling QA/QC Plan and recording of any deviations. The START Analytical Services Coordinator, Smita Sumbaly, will be the primary project team site contact with the subcontracted laboratory, if necessary.

START will arrange for the laboratory analyses. START personnel will transfer custody of the groundwater samples for shipment to the appropriate laboratory. The raw analytical data from the laboratory will be provided to the START Analytical Services Group for data validation.

The following sampling personnel will work on this project:

| Personnel | Responsibility |
|---|---|
| John F. Brennan (START) | PM / QA/QC |
| Thomas O'Neill | Sample Management Officer |
| Matt Coppolecchia | Sampling |
| Christoff Stannik | Sampling |
| Anthony Vandeven | Sampling |
| William Waddleton | Sampling |

The OSC has requested three week written analytical turnaround time. The following laboratories will provide the following analyses:

| Lab Name/Location | Sample Type | Parameters |
|---|---|---|
| TBD | Groundwater | TAL / TCL<br>Ammonia, Color, Fluoride<br>Foaming Agent, Hardness, Nitrate,<br>Nitrite, Odor, Oil & Grease<br>TPH, Total Dissolved Solids (TDS) |
| TBD | LNAPL | TAL / TCL<br>Oil & Grease, TPH |

## 6.0 QUALITY ASSURANCE AND QUALITY CONTROL REQUIREMENTS

The U.S. EPA OSC has specified the Quality Assurance level of 2 (QA-2) for this sampling and testing event. The following requirements apply to the respective QA Objectives and parameters identified in Section 3.0. The QA Protocols for a Level 2 QA objective sampling event are applicable to all sample matrices and include:

1. Sample documentation in the form of field log books, the appropriate field data sheets and chain of custody records (chain of custody records are optional for field screening locations)..

2. Calibration of all monitoring and/or field portable analytical equipment prior to collection and analyses of samples with results and/or performance check procedures/methods summarized and documented in field, personal and/or instrument log notebook.

3. Field or laboratory determined method detection limits (MDLs) will be recorded along with corresponding analytical sample, where appropriate.

4. Analytical holding times as determined from the time of sample collection through analysis. These will be documented in the field logbook or by the laboratory in the final deliverable package.

5. Initial and continuous instrument calibration data.

6. QC blank results (rinsate, trip, method, preparation, instrument, etc.), as applicable.

7. Collection and analyses of blind field duplicate and MS/MSD QC samples to provide a quantitative measure of the analytical precision and accuracy, as applicable.

8. Use of the following QC procedure for QC analyses and data validation:

Definitive Identification - (Choose one):

A. Screened Data - Confirm the identification of analytes via an EPA-approved method different from the screening method (field or lab) on at least 10% of the preliminary screened samples collected; provide documentation such as gas chromatograms, mass spectra, etc.

## 7.0 DELIVERABLES

The START PM, John F. Brennan, will maintain contact with the U.S. EPA OSC, Joseph Cosentino, to keep him informed of the technical and financial progress of the project. The communication will commence with the issuance of the work assignment and project scoping meeting. Activities under this project will be reported in status and trip reports and other deliverables (e.g., analytical reports) described herein. Activities will also be summarized in appropriate format for inclusion in monthly and annual reports.

The following deliverables will be provided under this project:

TRIP REPORT

A trip report will be prepared to provide deviations from the sampling plan and a detailed summary of sample assignments and difficulties encountered during the sampling event. The trip report will be prepared within one week of the last day of each sampling event. Information will be provided on time of major events, dates, and personnel on site (including affiliations).

MAPS / FIGURES

Maps depicting site layout, contaminant source areas, and sample locations will be included in the trip report, as appropriate.

ANALYTICAL REPORT

An analytical report will be prepared for samples analyzed under this plan. Information regarding the analytical methods or procedures employed, sample results, QA/QC results, chain of custody documentation, laboratory correspondence and raw data will be provided within this deliverable.

DATA REVIEW

A review of the data generated under this plan will be undertaken. The assessment of data acceptability or useability will be provided separately, or as part of the analytical report.

## 8.0 DATA VALIDATION

Data generated under this QA/QC Sampling Plan will be evaluated accordingly with appropriate criteria contained in the Removal Program Data Validation Procedures which accompany OSWER Directive #9360.4-1 and in accordance with U.S. EPA Region II guidelines.

Laboratory analytical results will be assessed by the data reviewer for compliance with required precision, accuracy, completeness, representativeness, and sensitivity.

## 9.0 SYSTEM AUDIT

The Field QA/QC Officer will observe the sampling operations and review the subsequent analytical results to ensure that the QA/QC project plan has been followed.

## 10.0 CORRECTIVE ACTIONS

All provisions will be taken in the field and laboratory to ensure that any problems that may develop will be dealt with as quickly as possible to ensure the continuity of the sampling program. Any deviations from this sampling plan will be noted in the final report.

ATTACHMENT A

SITE & WELL LOCATION PLANS

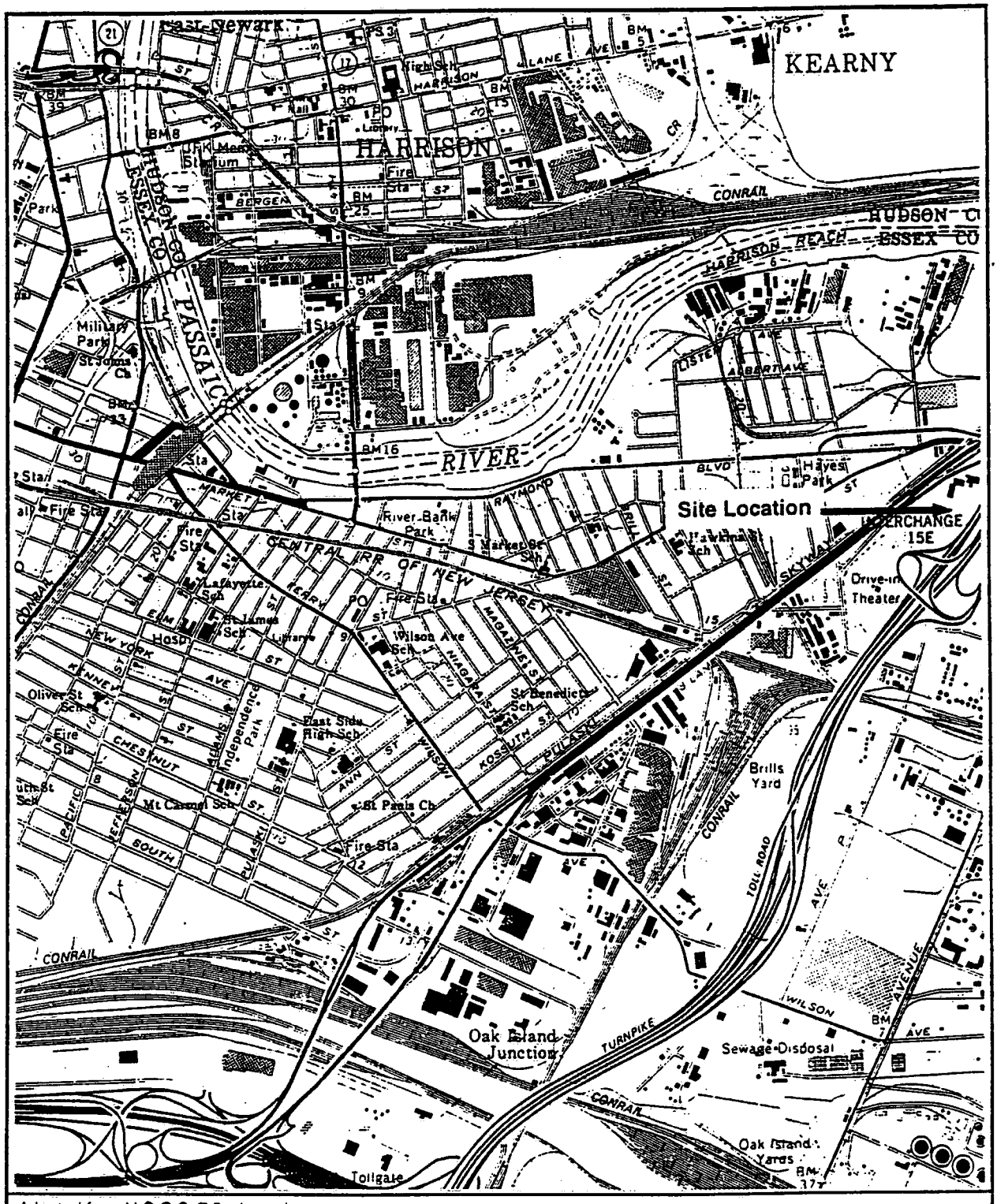
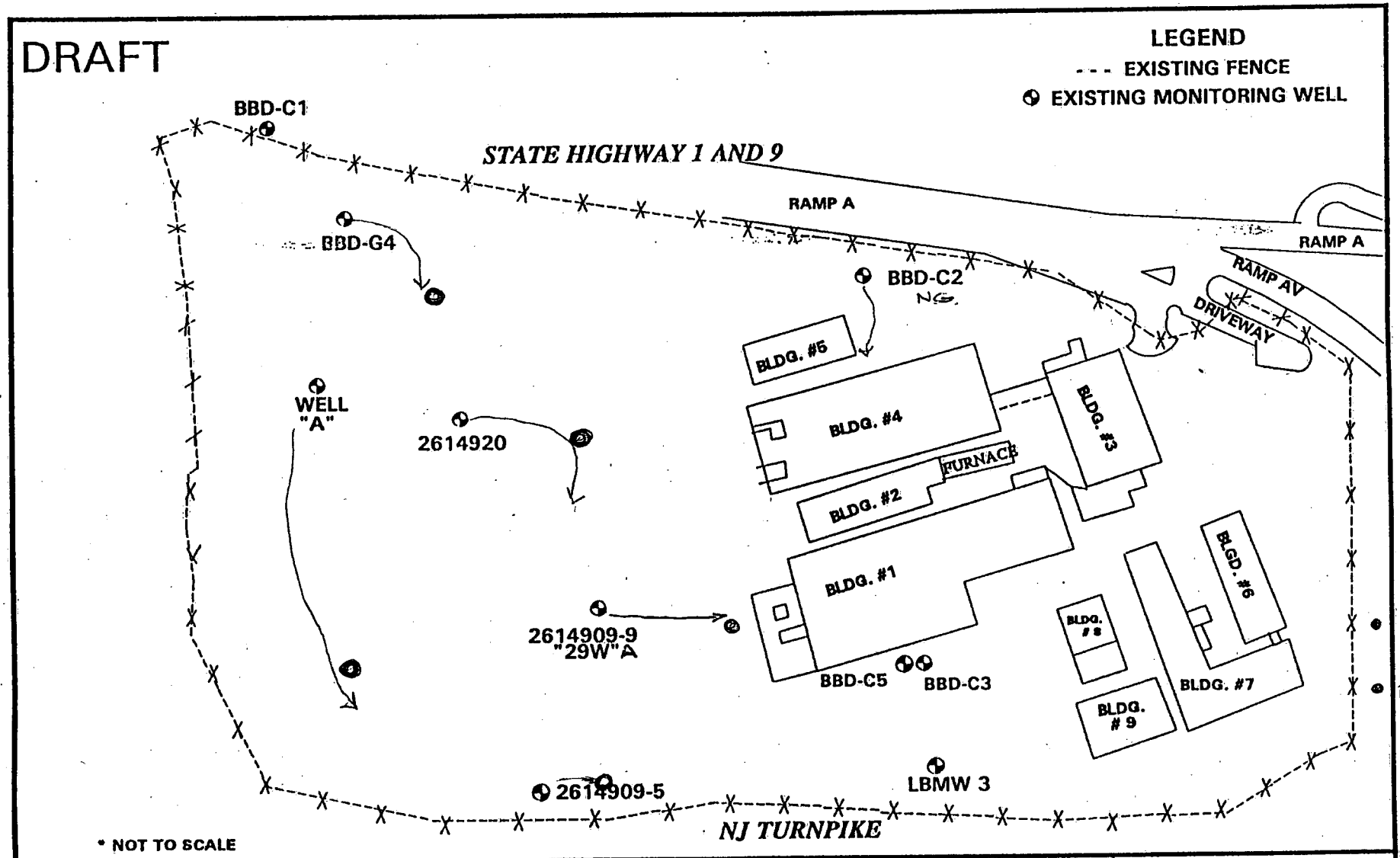



**FIGURE 2-1 SITE LOCATION MAP**
**BAYONNE BARREL & DRUM SITE**

DRAFT




| | | |
|---|---|---|
| WESTON MANAGERS DESIGNERS/CONSULTANTS<br>Roy F. Weston, Inc.<br>FEDERAL PROGRAMS DIVISION | EPA PM<br>J. Cosentino | Bayonne Barrel and Drum Site |
| IN ASSOCIATION WITH RESOURCE APPLICATION, Inc.<br>C.C. JOHNSON & MALHOTRA, P.C., R.E. SARRIERA ASSOCIATES,<br>PRC ENVIRONMENTAL MANAGEMENT, AND GRB ENVIRONMENTAL SERVICES, INC. | START PM<br>B. Lin | WELL LOCATION MAP |

ATTACHMENT B

GROUNDWATER WELL SAMPLING
EPA/ERT SOP #2007

# 2.0 GROUNDWATER WELL SAMPLING: SOP #2007

## 2.1 SCOPE AND APPLICATION

The objective of this Standard Operating Procedure (SOP) is to provide general reference information on sampling of groundwater wells. This guideline is primarily concerned with the collection of water samples from the saturated zone of the subsurface. Every effort must be made to ensure that the sample is representative of the particular zone of water being sampled. These procedures are designed to be used in conjunction with analyses for the most common types of groundwater contaminants (e.g., volatile and semi-volatile organic compounds, pesticides, metals, biological parameters).

## 2.2 METHOD SUMMARY

Prior to sampling a monitoring well, the well must be purged. This may be done with a number of instruments. The most common of these are the bailer, submersible pump, non-gas contact bladder pump and inertia pump. At a minimum, three well volumes should be purged, if possible. Equipment must be decontaminated prior to use and between wells. Once purging is completed and the correct laboratory-cleaned sample containers have been prepared, sampling may proceed. Sampling may be conducted with any of the above instruments, and need not be the same as the device used for purging. Care should be taken when choosing the sampling device as some will affect the integrity of the sample. Sampling equipment must also be decontaminated. Sampling should occur in a progression from the least to most contaminated well, if this information is known.

## 2.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The type of analysis for which a sample is being collected determines the type of bottle, preservative, holding time, and filtering requirements. Samples should be collected directly from the sampling device into appropriate laboratory-cleaned containers. Check that a Teflon liner is present in the cap, if required. Attach a sample identification label. Complete a field data sheet, a chain of custody form and record all pertinent data in the site logbook.

Samples shall be appropriately preserved, labelled, logged, and placed in a cooler to be maintained at 4°C. Samples must be shipped well before the holding time is over and ideally should be shipped within 24 hours of sample collection. It is imperative that these samples be shipped or delivered daily to the analytical laboratory in order to maximize the time available for the laboratory to perform the analysis. The bottles should be shipped with adequate packing and cooling to ensure that they arrive intact.

Certain conditions may require special handling techniques. For example, treatment of a sample for volatile organic (VOA) analysis with sodium thiosulfate preservative is required if there is residual chlorine in the water (such as public water supply) that could cause free radical chlorination and change the identity of the original contaminants. However, sodium thiosulfate should not be used if chlorine is not present in the water. Special requirements must be determined prior to conducting fieldwork.

## 2.4 INTERFERENCES AND POTENTIAL PROBLEMS

### 2.4.1 General

The primary goal of groundwater sampling is to obtain a representative sample of the groundwater body. Analysis can be compromised by field personnel in two primary ways: (1) taking an unrepresentative sample, or (2) by incorrect handling of the sample. There are numerous ways of introducing foreign contaminants into a sample, and these must be avoided by following strict sampling procedures and only utilizing trained field personnel.

### 2.4.2 Purging

In a non-pumping well, there will be little or no vertical mixing of the water, and stratification will

occur. The well water in the screened section will mix with the groundwater due to normal flow patterns, but the well water above the screened section will remain isolated, become stagnant and lack the VOAs representative of the groundwater. Sampling personnel should realize that stagnant water may contain foreign material inadvertently or deliberately introduced from the surface, resulting in an unrepresentative sample. To safeguard against collecting nonrepresentative stagnant water, follow these guidelines during sampling:

- As a general rule, all monitoring wells should be pumped or bailed prior to sampling. Purge water should be containerized on site or handled as specified in the site-specific project plan. Evacuation of a minimum of one volume of water in the well casing, and preferably three to five volumes, is recommended for a representative sample. In a high-yielding ground water formation and where there is no stagnant water in the well above the screened section, evacuation prior to sample withdrawal is not as critical. However, in all cases where the monitoring data is to be used for enforcement actions, evacuation is recommended.

- For wells that can be pumped or bailed to dryness with the equipment being used, the well should be evacuated and allowed to recover prior to sample withdrawal. If the recovery rate is fairly rapid and the schedule allows, evacuation of more than one volume of water is preferred. If recovery is slow, sample the well upon recovery after one evacuation.

- A nonrepresentative sample can also result from excessive pre-pumping of the monitoring well. Stratification of the leachate concentration in the groundwater formation may occur, or heavier-than-water compounds may sink to the lower portions of the aquifer. Excessive pumping can dilute or increase the contaminant concentrations from what is representative of the sampling point of interest.

### 2.4.3 Materials

Samplers and evacuation equipment (bladders, pumps, bailers, tubing, etc.) should be limited to those made with stainless steel, Teflon, and glass in areas where concentrations are expected to be at or near the detection limit. The tendency of organics to leach into and out of many materials make the selection of materials critical for trace analyses. The use of plastics, such as PVC or polyethylene, should be avoided when analyzing for organics. However, PVC may be used for evacuation equipment as it will not come in contact with the sample.

Table 2 on page 7 discusses the advantages and disadvantages of certain equipment.

## 2.5 EQUIPMENT/APPARATUS

### 2.5.1 General

- water level indicator
  - electric sounder
  - steel tape
  - transducer
  - reflection sounder
  - airline
- depth sounder
- appropriate keys for well cap locks
- steel brush
- HNU or OVA (whichever is most appropriate)
- logbook
- calculator
- field data sheets
- chain of custody forms
- forms and seals
- sample containers
- Engineer's rule
- sharp knife (locking blade)
- tool box (to include at least: screwdrivers, pliers, hacksaw, hammer, flashlight, adjustable wrench)
- leather work gloves
- appropriate health and safety gear
- 5-gallon pail
- plastic sheeting
- shipping containers
- packing materials
- bolt cutters
- Ziploc plastic bags
- containers for evacuation of liquids
- decontamination solutions
- tap water
- non-phosphate soap
- several brushes

## Table 2: Advantages and Disadvantages of Various Groundwater Sampling Devices

| Device | Advantages | Disadvantages |
|---|---|---|
| Bailer | • The only practical limitations are size and materials<br>• No power source needed<br>• Portable<br>• Inexpensive; it can be dedicated and hung in a well reducing the chances of cross-contamination<br>• Minimal outgassing of volatile organics while sample is in bailer<br>• Readily available<br>• Removes stagnant water first<br>• Rapid, simple method for removing small volumes of purge water | • Time consuming, especially for large wells<br>• Transfer of sample may cause aeration |
| Submersible Pump | • Portable; can be used on an unlimited number of wells<br>• Relatively high pumping rate (dependent on depth and size of pump)<br>• Generally very reliable; does not require priming | • Potential for effects on analysis of trace organics<br>• Heavy and cumbersome, particularly in deeper wells<br>• Expensive<br>• Power source needed<br>• Susceptible to damage from silt or sediment<br>• Impractical in low yielding or shallow wells |
| Non-Gas Contact Bladder Pump | • Maintains integrity of sample<br>• Easy to use | • Difficult to clean although dedicated tubing and bladder may be used<br>• Only useful to approximately 100 feet in depth<br>• Supply of gas for operation (bottled gas and/or compressor) is difficult to obtain and is cumbersome |
| Suction Pump | • Portable, inexpensive, and readily available | • Only useful to approximately 25 feet or less in depth<br>• Vacuum can cause loss of dissolved gases and volatile organics<br>• Pump must be primed and vacuum is often difficult to maintain<br>• May cause pH modification |
| Inertia Pump | • Portable, inexpensive, and readily available<br>• Rapid method for purging relatively shallow wells | • Only useful to approximately 70 feet or less in depth<br>• May be time consuming to use<br>• Labor intensive<br>• WaTerra pump is only effective in 2-inch diameter wells |

- pails or tubs
- aluminum foil
- garden sprayer
- preservatives
- distilled or deionized water

### 2.5.2 Bailer

- clean, decontaminated bailer(s) of appropriate size and construction material
- nylon line, enough to dedicate to each well
- Teflon-coated bailer wire
- sharp knife
- aluminum foil (to wrap clean bailers)
- 5-gallon bucket

### 2.5.3 Submersible Pump

- pump(s)
- generator (110, 120, or 240 volt) or 12-volt battery if inaccessible to field vehicle
- 1-inch black PVC coil pipe -- enough to dedicate to each well
- hose clamps
- safety cable
- tool box supplement
  - pipe wrenches, 2
  - wire strippers
  - electrical tape
  - heat shrink
  - hose connectors
  - Teflon tape
- winch or pulley
- gasoline for generator
- flow meter with gate valve
- 1-inch nipples and various plumbing (i.e., pipe connectors)

### 2.5.4 Non-Gas Contact Bladder Pump

- non-gas contact bladder pump
- compressor or nitrogen gas tank
- batteries and charger
- Teflon tubing -- enough to dedicate to each well
- Swagelock fitting
- toolbox supplements -- same as submersible pump

### 2.5.5 Suction Pump

- pump
- black coil tubing -- enough to dedicate to each well
- gasoline -- if required
- toolbox
- plumbing fittings
- flow meter with gate valve

### 2.5.6 Inertia Pump

- pump assembly (WaTerra pump, piston pump)
- 5-gallon bucket

## 2.6 REAGENTS

Reagents will be utilized for preservation of samples and for decontamination of sampling equipment. The preservation required is specified by the analysis to be performed. Decontamination solutions are specified in ERT SOP #2006, Sampling Equipment Decontamination.

## 2.7 PROCEDURES

### 2.7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are needed.

2. Obtain necessary sampling and monitoring equipment.

3. Decontaminate or preclean equipment, and ensure that it is in working order.

4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.

5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.

6. Identify and mark all sampling locations.

### 2.7.2 Field Preparation

1. Start at the least contaminated well, if known.

2. Lay plastic sheeting around the well to minimize likelihood of contamination of equipment from soil adjacent to the well.

3. Remove locking well cap, note location, time of day, and date in field notebook or an appropriate log form.

4. Remove well casing cap.

5. Screen headspace of well with an appropriate monitoring instrument to determine the presence of volatile organic compounds and record in site logbook.

6. Lower water level measuring device or equivalent (i.e., permanently installed transducers or airline) into well until water surface is encountered.

7. Measure distance from water surface to reference measuring point on well casing or protective barrier post and record in site logbook. Alternatively, if there is no reference point, note that water level measurement is from top of steel casing, top of PVC riser pipe, from ground surface, or some other position on the well head.

8. Measure total depth of well (do this at least twice to confirm measurement) and record in site logbook or on log form.

9. Calculate the volume of water in the well and the volume to be purged using the calculations in Section 2.8.

10. Select the appropriate purging and sampling equipment.

### 2.7.3 Evacuation of Static Water (Purging)

The amount of flushing a well receives prior to sample collection depends on the intent of the monitoring program as well as the hydrogeologic conditions. Programs where overall quality determination of water resources are involved may require long pumping periods to obtain a sample that is representative of a large volume of that aquifer. The pumped volume can be determined prior to sampling so that the sample is a composite of known volume of the aquifer, or the well can be pumped until the stabilization of parameters such as temperature, electrical conductance, or pH has occurred.

However, monitoring for defining a contaminant plume requires a representative sample of a small volume of the aquifer. These circumstances require that the well be pumped enough to remove the stagnant water but not enough to induce flow from other areas. Generally, three well volumes are considered effective, or calculations can be made to determine, on the basis of the aquifer parameters and well dimensions, the appropriate volume to remove prior to sampling.

During purging, water level measurements may be taken regularly at 15- to 30-second intervals. This data may be used to compute aquifer transmissivity and other hydraulic characteristics.

The following well evacuation devices are most commonly used. Other evacuation devices are available, but have been omitted in this discussion due to their limited use.

#### *Bailer*

Bailers are the simplest purging device used and have many advantages. They generally consist of a rigid length of tube, usually with a ball check-valve at the bottom. A line is used to lower the bailer into the well and retrieve a volume of water. The three most common types of bailer are PVC, Teflon, and stainless steel.

This manual method of purging is best suited to shallow or narrow diameter wells. For deep, larger diameter wells which require evacuation of large volumes of water, other mechanical devices may be more appropriate.

Bailing equipment includes a clean decontaminated bailer, Teflon or nylon line, a sharp knife, and plastic sheeting.

1. Determine the volume of water to be purged as described in Section 2.7.2, Field Preparation.

2. Lay plastic sheeting around the well to prevent contamination of the bailer line with foreign materials.

3. Attach the line to the bailer and lower until the bailer is completely submerged.

4. Pull bailer out ensuring that the line either falls onto a clean area of plastic sheeting or never touches the ground.

5. Empty the bailer into a pail until full to determine the number of bails necessary to achieve the required purge volume.

6. Thereafter, pour the water into a container and dispose of purge waters as specified in the site-specific project plan.

### *Submersible Pump*

Submersible pumps are generally constructed of plastic, rubber, and metal parts which may affect the analysis of samples for certain trace organics and inorganics. As a consequence, submersible pumps may not be appropriate for investigations requiring analyses of samples for trace contaminants. However, they are still useful for pre-sample purging. However, the pump must have a check valve to prevent water in the pump and the pipe from rushing back into the well.

Submersible pumps generally use one of two types of power supplies, either electric or compressed gas. Electric pumps can be powered by a 12-volt DC rechargeable battery, or a 110- or 220-volt AC power supply. Those units powered by compressed gas normally use a small electric compressor which also needs 12-volt DC or 110-volt AC power. They may also utilize compressed gas from bottles. Pumps differ according to the depth and diameter of the monitoring wells.

1. Determine the volume of water to be purged as described in section 2.7.2, Field Preparation.

2. Lay plastic sheeting around the well to prevent contamination of pumps, hoses or lines with foreign materials.

3. Assemble pump, hoses and safety cable, and lower the pump into the well. Make sure the pump is deep enough so that purging does not evacuate all the water. (Running the pump without water may cause damage.)

4. Attach flow meter to the outlet hose to measure the volume of water purged.

5. Attach power supply, and purge well until specified volume of water has been evacuated (or until field parameters, such as temperature, pH, conductivity, etc. have stabilized). Do not allow the pump to run dry. If the pumping rate exceeds the well recharge rate, lower the pump further into the well, and continue pumping.

6. Collect and dispose of purge waters as specified in the site-specific project plan.

### *Non-Contact Gas Bladder Pump*

For this procedure, an all stainless-steel and Teflon Middleburg-squeeze bladder pump (e.g., IEA, TIMCO, Well Wizard, Geoguard, and others) is used to provide the least amount of material interference to the sample (Barcelona, 1985). Water comes into contact with the inside of the bladder (Teflon) and the sample tubing, also Teflon, that may be dedicated to each well. Some wells may have permanently installed bladder pumps (i.e., Well Wizard, Geoguard), that will be used to sample for all parameters.

1. Assemble Teflon tubing, pump and charged control box.

2. Use the same procedure for purging with a bladder pump as for a submersible pump.

3. Be sure to adjust flow rate to prevent violent jolting of the hose as sample is drawn in.

### *Suction Pump*

There are many different types of suction pumps. They include: centrifugal, peristaltic and diaphragm. Diaphragm pumps can be used for well evacuation at a fast pumping rate and sampling at a low pumping rate. The peristaltic pump is a low-volume pump that uses rollers to squeeze the flexible tubing, thereby creating suction. This tubing can be dedicated to a well to prevent cross-contamination. Peristaltic pumps, however, require a power source.

1. Assemble the pump, tubing, and power source if necessary.

2. To purge with a suction pump, follow the exact procedures outlined for the submersible pump.

### *Inertia Pump*

Inertia pumps, such as the WaTerra pump and piston pump, are manually operated. They are appropriate to use when wells are too deep to bail by hand, but are not inaccessible enough to warrant an automatic (submersible, etc.) pump. These

pumps are made of plastic and may be either decontaminated or discarded, after use.

1. Determine the volume of water to be purged as described in Section 2.7.2, Field Preparation.

2. Lay plastic sheeting around the well to prevent contamination of pumps or hoses with foreign materials.

3. Assemble pump, and lower to the appropriate depth in the well.

4. Begin pumping manually, discharging water into a 5-gallon bucket (or other graduated vessel). Purge until specified volume of water has been evacuated (or until field parameters such as temperature, pH, conductivity, etc. have stabilized).

5. Collect and dispose of purge waters as specified in the site-specific project plan.

## 2.7.4 Sampling

Sample withdrawal methods require the use of pumps, compressed air, bailers, and samplers. Ideally, purging and sample withdrawal equipment should be completely inert, economical to use, easily cleaned, sterilized, reusable, able to operate at remote sites in the absence of power resources, and capable of delivering variable rates for sample collection.

There are several factors to take into consideration when choosing a sampling device. Care should be taken when reviewing the advantages or disadvantages of any one device. It may be appropriate to use a different device to sample than that which was used to purge. The most common example of this is the use of a submersible pump to purge and a bailer to sample.

### *Bailer*

The positive-displacement volatile sampling bailer (by GPI) is perhaps the most appropriate for collection of water samples for volatile analysis. Other bailer types (messenger, bottom fill, etc.) are less desirable, but may be mandated by cost and site conditions. Generally, bailers can provide an acceptable sample, providing that sampling personnel use extra care in the collection process.

1. Surround the monitoring well with clean plastic sheeting.

2. Attach a line to the bailer. If a bailer was used for purging, the same bailer and line may be used for sampling.

3. Lower the bailer slowly and gently into the well, taking care not to shake the casing sides or to splash the bailer into the water. Stop lowering at a point adjacent to the screen.

4. Allow bailer to fill and then slowly and gently retrieve the bailer from the well, avoiding contact with the casing, so as not to knock flakes of rust or other foreign materials into the bailer.

5. Remove the cap from the sample container and place it on the plastic sheet or in a location where it will not become contaminated. See Section 2.7.7 for special considerations on VOA samples.

6. Begin pouring slowly from the bailer.

7. Filter and preserve samples as required by sampling plan.

8. Cap the sample container tightly and place pre-labeled sample container in a carrier.

9. Replace the well cap.

10. Log all samples in the site logbook and on field data sheets and label all samples.

11. Package samples and complete necessary paperwork.

12. Transport sample to decontamination zone to prepare it for transport to analytical laboratory.

### *Submersible Pump*

Although it is recommended that samples not be collected with a submersible pump due to the reasons stated in Section 2.4, there are some situations where they may be used.

1. Allow the monitoring well to recharge after purging, keeping the pump just above the screened section.

2. Attach gate valve to hose (if not already fitted), and reduce flow of water to a manageable sampling rate.

3. Assemble the appropriate bottles.

4. If no gate valve is available, run the water down the side of a clean jar and fill the sample bottles from the jar.

5. Cap the sample container tightly and place pre-labeled sample container in a carrier.

6. Replace the well cap.

7. Log all samples in the site logbook and on the field data sheets and label all samples.

8. Package samples and complete necessary paperwork.

9. Transport sample to decontamination zone for preparation for transport to analytical laboratory.

10. Upon completion, remove pump and assembly and fully decontaminate prior to setting into the next sample well. Dedicate the tubing to the hole.

### *Non-Gas Contact Bladder Pump*

The use of a non-gas contact positive displacement bladder pump is often mandated by the use of dedicated pumps installed in wells. These pumps are also suitable for shallow (less than 100 feet) wells. They are somewhat difficult to clean, but may be used with dedicated sample tubing to avoid cleaning. These pumps require a power supply and a compressed gas supply (or compressor). They may be operated at variable flow and pressure rates making them ideal for both purging and sampling.

Barcelona (1984) and Nielsen (1985) report that the non-gas contact positive displacement pumps cause the least amount of alteration in sample integrity as compared to other sample retrieval methods.

1. Allow well to recharge after purging.

2. Assemble the appropriate bottles.

3. Turn pump on, increase the cycle time and reduce the pressure to the minimum that will allow the sample to come to the surface.

4. Cap the sample container tightly and place pre-labeled sample container in a carrier.

5. Replace the well cap.

6. Log all samples in the site logbook and on field data sheets and label all samples.

7. Package samples and complete necessary paperwork.

8. Transport sample to decontamination zone for preparation for transport to analytical laboratory.

9. On completion, remove the tubing from the well and either replace the Teflon tubing and bladder with new dedicated tubing and bladder or rigorously decontaminate the existing materials.

10. Collect non-filtered samples directly from the outlet tubing into the sample bottle.

11. For filtered samples, connect the pump outlet tubing directly to the filter unit. The pump pressure should remain decreased so that the pressure build-up on the filter does not blow out the pump bladder or displace the filter. For the Geotech barrel filter, no actual connections are necessary so this is not a concern.

### *Suction Pump*

In view of the limitations of suction pumps, they are not recommended for sampling purposes.

### *Inertia Pump*

Inertia pumps may be used to collect samples. It is more common, however, to purge with these pumps and sample with a bailer.

1. Following well evacuation, allow the well to recharge.

2. Assemble the appropriate bottles.

3. Since these pumps are manually operated, the flow rate may be regulated by the sampler. The sample may be discharged from the pump outlet directly into the appropriate sample container.

4. Cap the sample container tightly and place pre-labeled sample container in a carrier.

5. Replace the well cap.

6. Log all samples in the site logbook and on field data sheets and label all samples.

7. Package samples and complete necessary paperwork.

8. Transport sample to decontamination zone for preparation for transport to analytical laboratory.

9. Upon completion, remove pump and decontaminate or discard, as appropriate.

### 2.7.5 Filtering

For samples that require filtering, such as samples which will be analyzed for total metals, the filter must be decontaminated prior to use and between uses. Filters work by two methods. A barrel filter such as the "Geotech" filter works with a bicycle pump, which is used to build up positive pressure in the chamber containing the sample. The sample is then forced through the filter paper (minimum size 0.45 $\mu$m) into a jar placed underneath. The barrel itself is filled manually from the bailer or directly via the hose of the sampling pump. The pressure must be maintained up to 30 psi by periodic pumping.

A vacuum type filter involves two chambers, the upper chamber contains the sample and a filter (minimum size 0.45 $\mu$m) divides the chambers. Using a hand pump or a Gilian type pump, air is withdrawn from the lower chamber, creating a vacuum and thus causing the sample to move through the filter into the lower chamber where it is drained into a sample jar, repeated pumping may be required to drain all the sample into the lower chamber. If preservation of the sample is necessary, this should be done after filtering.

### 2.7.6 Post Operation

After all samples are collected and preserved, the sampling equipment should be decontaminated prior to sampling another well. This will prevent cross-contamination of equipment and monitoring wells between locations.

1. Decontaminate all equipment.

2. Replace sampling equipment in storage containers.

3. Prepare and transport water samples to the laboratory. Check sample documentation and make sure samples are properly packed for shipment.

### 2.7.7 Special Considerations for VOA Sampling

The proper collection of a sample for volatile organics requires minimal disturbance of the sample to limit volatilization and therefore a loss of volatiles from the sample.

Sample retrieval systems suitable for the valid collection of volatile organic samples are: positive displacement bladder pumps, gear driven submersible pumps, syringe samplers and bailers (Barcelona, 1984; Nielsen, 1985). Field conditions and other constraints will limit the choice of appropriate systems. The focus of concern must be to provide a valid sample for analysis, one which has been subjected to the least amount of turbulence possible.

The following procedures should be followed:

1. Open the vial, set cap in a clean place, and collect the sample during the middle of the cycle. When collecting duplicates, collect both samples at the same time.

2. Fill the vial to just overflowing. Do not rinse the vial, nor excessively overfill it. There should be a convex meniscus on the top of the vial.

3. Check that the cap has not been contaminated (splashed) and carefully cap the vial. Place the cap directly over the top and screw down firmly. Do not overtighten and break the cap.

4. Invert the vial and tap gently. Observe vial for at least 10 seconds. If an air bubble appears, discard the sample and begin again. It is imperative that no entrapped air is in the sample vial.

5. Immediately place the vial in the protective foam sleeve and place into the cooler, oriented so that it is lying on its side, not straight up.

6. The holding time for VOAs is 7 days. Samples should be shipped or delivered to the laboratory daily so as not to exceed the holding time. Ensure that the samples remain at 4°C, but do not allow them to freeze.

## 2.8 CALCULATIONS

There are no calculations necessary to implement this procedure. However, if it is necessary to calculate the volume of the well, utilize the following equation:

$$\text{Well volume} = nr^2h\,(cf) \quad \text{[Equation 1]}$$

where:

- n = pi
- r = radius of monitoring well (feet)
- h = height of the water column (feet) [This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]
- cf = conversion factor (gal/ft$^3$) = 7.48 gal/ft$^3$ [In this equation, 7.48 gal/ft$^3$ is the necessary conversion factor.]

Monitoring wells are typically 2, 3, 4, or 6 inches in diameter. If you know the diameter of the monitoring well, there are a number of standard conversion factors which can be used to simplify the equation above.

The volume, in gallons per linear foot, for various standard monitoring well diameters can be calculated as follows:

$$v = nr^2\,(cf) \quad \text{[Equation 2]}$$

where:

- v = volume in gallons per linear foot
- n = pi
- r = radius of monitoring well (feet)
- cf = conversion factor (7.48 gal/ft$^3$)

For a 2-inch diameter well, the volume in gallons per linear foot can be calculated as follows:

$$v = nr^2\,(cf) \quad \text{[Equation 2]}$$
$$= 3.14\,(1/12\text{ ft})^2\ 7.48\text{ gal/ft}^3$$
$$= 0.1632\text{ gal/ft}$$

Remember that if you have a 2-inch diameter, well you must convert this to the radius in feet to be able to use the equation.

The volume in gallons per linear foot for the common size monitoring wells are as follows:

| Well Diameter | v (volume in gal/ft.) |
|---|---|
| 2 inches | 0.1632 |
| 3 inches | 0.3672 |
| 4 inches | 0.6528 |
| 6 inches | 1.4688 |

If you utilize the conversion factors above, Equation 1 should be modified as follows:

$$\text{Well volume} = (h)(v) \quad \text{[Equation 3]}$$

where:

- h = height of water column (feet)
- v = volume in gallons per linear foot as calculated from Equation 2

## 2.9 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

- All data must be documented on field data sheets or within site logbooks.

- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless

otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

## 2.10 DATA VALIDATION

This section is not applicable to this SOP.

## 2.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA and specific health and safety procedures. More specifically, depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. The site health and safety plan should be reviewed with specific emphasis placed on the protection program planned for the well sampling tasks. Standard safe operating practices should be followed such as minimizing contact with potential contaminants in both the vapor phase and liquid matrix through the use of respirators and disposable clothing.

For volatile organic contaminants:

- Avoid breathing constituents venting from the well.
- Pre-survey the well head-space with an FID/PID prior to sampling.
- If monitoring results indicate organic constituents, sampling activities may be conducted in Level C protection. At a minimum, skin protection will be afforded by disposable protective clothing.

Physical hazards associated with well sampling are:

- Lifting injuries associated with pump and bailer retrieval; moving equipment.
- Use of pocket knives for cutting discharge hose.
- Heat/cold stress as a result of exposure to extreme temperatures (may be heightened by protective clothing).
- Slip, trip, fall conditions as a result of pump discharge.
- Restricted mobility due to the wearing of protective clothing.

# ATTACHMENT C

# LOW STRESS PURGING AND SAMPLING SOP

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II

DATE: MAR 2 0 1998

SUBJECT: Final USEPA Region II Low Stress (Low Flow) Ground Water Sampling Standard Operating Procedure.

FROM: Barbara A. Finazzo, Director
Division of Environmental Science and Assessment

TO:

Kathleen C. Callahan, Director (DEPP)
Richard L. Caspe, Director (ERRD)
Conrad Simon, Director (DECA)
Carl Soderberg, Director (CEPD)

Attached for your information and distribution to your divisions please find the USEPA Region II Low Stress (Low Flow) Ground Water Sampling Standard Operating Procedure (SOP). This SOP is now the standard method for collecting ground water samples for the Region.

In the majority of cases, low stress sampling has been demonstrated to result in samples which are more representative of nascent ground water quality. Samples collected using the low stress technique usually display lower turbidity, and, where present, higher concentrations of volatile compounds. Adoption of the low stress SOP is consistent with Region II's commitment to obtaining representative samples for purposes of characterization and decision making. However, it does not preclude use of other methods on a case by case basis.

We are in the process of developing a hands-on training for EPA and state personnel, and plan to make it available here in Edison this summer.

If you have any questions regarding these matters, please call me at (732) 321-6754, or have your staffs call Dennis McChesney at (732) 321-6729.

Attachment

cc. W. Muszynski, DRA, w/o attachment

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

# GROUND WATER SAMPLING PROCEDURE
# LOW STRESS (Low Flow) PURGING AND SAMPLING

## I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is th EPA Region II standard method for collecting low stress (low flow) ground water samples from monitoring wells. Low stress Purging ar Sampling results in collection of ground water samples from monitc wells that are representative of ground water conditions in the geological formation. This is accomplished by minimizing stress c the geological formation and minimizing disturbance of sediment th has collected in the well. The procedure applies to monitoring we that have an inner casing with a diameter of 2.0 inches or greater and maximum screened intervals of ten feet unless multiple interva are sampled. The procedure is appropriate for collection of ground water samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminan in association with all EPA programs.

This procedure does not address the collection of light or dense n aqueous phase liquids (LNAPL or DNAPL) samples, and should be used aqueous samples only. For sampling NAPLs, the reader is referred t the following EPA publications: DNAPL Site Evaluation (Cohen & Mers 1993) and the RCRA Ground-Water Monitoring: Draft Technical Guidanc (EPA/530-R-93-001), and references therein.

## II. METHOD SUMMARY

The purpose of the low stress purging and sampling procedure is to collect ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well casing.

Sampling at the prescribed (low) flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing an additional filtered sample from the same well. Second, this procedure minimizes aeration of the ground water during sample collection, which improves the sample quality for VOC analysis. Third, in most cases the procedure significantly reduces the volume of ground water purged from a well and the costs associated with its proper treatment and disposal.

## III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of one or more key indicator parameters to stabilize; c) cascading of water and/or formation of air bubbles in the tubing; and d) cross-contamination between wells.

### Insufficient Yield

Wells with insufficient yield (i.e., low recharge rate of the well) may dewater during purging. Care should be taken to avoid loss of pressure in the tubing line due to dewatering of the well below the level of the pump's intake. Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should therefore be avoided to the extent possible in all cases. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

### Failure to Stabilize Key Indicator Parameters

If one or more key indicator parameters fails to stabilize after 4 hours, one of three options should be considered: a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the

log book; c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book; or d) Secure the well, purge and collect samples the next day (preferred). The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

**Cascading**

To prevent cascading and/or air bubble formation in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4 or 3/8 inch ID) to ensure that the tubing remains filled with ground water during sampling.

**Cross-Contamination**

To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more thorough "daily" decontamination procedures between sampling of each well in addition to the start of each sampling day (see Section VII, below).

**Equipment Failure**

Adequate equipment should be on-hand so that equipment failures do not adversely impact sampling activities.

## IV. PLANNING DOCUMENTATION AND EQUIPMENT

- Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify the type of pump and other equipment to be used. The QAPP must also specify the depth to which the pump intake should be lowered in each well. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake. In all cases, the target depth must be approved by the EPA hydrogeologist or EPA project scientist.

- Well construction data, location map, field data from last sampling event.
- Polyethylene sheeting.
- Flame Ionization Detector (FID) and Photo Ionization Detector (PID).
- Adjustable rate, positive displacement ground water sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may only be used for inorganic sample collection.
- Interface probe or equivalent device for determining the presence or absence of NAPL.
- Teflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.
- Water level measuring device, minimum 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).
- Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).
- Power source (generator, nitrogen tank, etc.).
- Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Specific conductance, pH, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.
- Decontamination supplies (see Section VII, below).
- Logbook (see Section VIII, below).

- Sample bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags or labels, chain of custody.

## V. SAMPLING PROCEDURES

### Pre-Sampling Activities

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for placement of monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID and FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the opened well with a PID and an FID instrument and record the reading in the field log book.

6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled prior to purging. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of

any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the measurement or sampling of any DNAPLs and the low-stress purging and sampling of the ground water.

**Sampling Procedures**

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified for that well in the EPA-approved QAPP or a depth otherwise approved by the EPA hydrogeologist or EPA project scientist. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well at 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

-0.1 for pH
+3% for specific conductance (conductivity)
+10 mv for redox potential
+10% for DO and turbidity

Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

13. Collect Samples: Collect samples at a flow rate between 100 and 250 ml/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container.

    Ground water samples to be analyzed for volatile organic compounds (VOCs) require pH adjustment. The appropriate EPA Program Guidance should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for VOC sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 ml). Ground water purged from the well prior to sampling can be used for this purpose.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for resampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

## VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance

should be consulted in preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

- Field duplicates
- Trip blanks for VOCs only
- Equipment blank (not necessary if equipment is dedicated to the well)

As noted above, ground water samples should be collected systematically from wells with the lowest level of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

## VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using "daily decon" procedures (see #17, below) prior to their initial use. For centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon").

EPA's field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon," see #18 below).

### 17. Daily Decon

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Disassemble pump.

E) Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water.

G) Rinse the following pump parts with distilled/ deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing.

H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid ($HNO_3$).

I) Rinse impeller assembly with potable water.

J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K) Rinse impeller assembly with distilled/deionized water.

18. **Between-Well Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

## VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

- Well identification number and physical condition.
- Well depth, and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid layers and detection method.
- Collection method for immiscible liquid layers.
- Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.

## IX. REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation, C.K. Smoley Press, Boca Raton, Florida.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures, EPA/540/S-95/504.

U.S. EPA, 1993, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93-001.

U.S. EPA Region II, 1989, CERCLA Quality Assurance Manual.

ATTACHMENT D

WELL DEVELOPMENT
EPA/ERT SOP#2156

# 6.0 WELL DEVELOPMENT: SOP #2156

## 6.1 SCOPE AND APPLICATION

The purpose of monitoring well development is to ensure removal of fines from the vicinity of the well screen. This allows free flow of water from the formation into the well and also reduces the turbidity of the water during sampling events. The most common well development methods are: surging, jetting, and overpumping.

Surging involves raising and lowering a surge block or surge plunger inside the well. The resulting motion surges water into the formation and loosens sediment to be pulled from the formation into the well. Occasionally, sediment must be removed from the well with a sand bailer to prevent sand locking of the surge block. This method may cause the sand pack around the screen to be displaced to a degree that damages its value as a filtering medium. For example, channels or voids may form near the screen if the filter pack sloughs away during surging (Keely and Boateng, 1987).

Jetting involves lowering a small diameter pipe into the well to a few feet above the well screen, and injecting water or air through the pipe under pressure so that sediments at the bottom are geysered out the top of the well. It is important not to jet air or water directly across the screen. This may cause fines in the well to be driven into the entrance of the screen openings thereby causing blockages.

Overpumping involves pumping at a rate rapid enough to draw the water level in the well as low as possible, and allowing it to recharge. This process is repeated until sediment-free water is produced. Overpumping is not as vigorous as surging and jetting and is probably the most desirable for monitoring well development.

## 6.2 METHOD SUMMARY

Development of a well should occur as soon as practical after installation, but not sooner than 48 hours after grouting is completed, if a rigorous well development is being used. If a less rigorous method, such as bailing, is used for development, it may be initiated shortly after installation. The main concern is that the method being used for development does not interfere with allowing the grout to set.

Open the monitoring well, take initial measurements (e.g. head space air monitoring readings, water level, well depth, pH, temperature, and specific conductivity) and record results in the site logbook. Develop the well by the appropriate method (i.e., overpumping, jetting, or surging) to accommodate site conditions and project requirements. Continue until the developed water is clear and free of sediment. Containerize all discharge water from known or suspected contaminated areas. Record final measurements in the logbook. Decontaminate equipment as appropriate prior to use in the next well.

## 6.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this Standard Operating Procedure (SOP).

## 6.4 INTERFERENCES AND POTENTIAL PROBLEMS

The following interferences or problems may occur during well development:

- The possibility of disturbing the filter pack increases with surging and jetting well development methods.
- The introduction of external water or air by jetting may alter the hydrochemistry of the aquifer.

## 6.5 EQUIPMENT/APPARATUS

The type of equipment used for well development is dependent on the diameter of the well. For example, submersible pumps cannot be used for well development unless the wells are 4 inches or greater in diameter, because the smallest

development
- quantity of water removed and time of removal
- type and size/capacity of pump and/or bailer used
- description of well development techniques used

### 6.7.3 Post Operation

1. Decontaminate all equipment.

2. Store containers of purge water produced during development in a safe and secure area.

3. After the first round of analytical results have been received, determine and implement the appropriate purge water disposal method.

## 6.8 CALCULATIONS

There are no calculations necessary to implement this procedure. However, if it is necessary to calculate the volume of the well, utilize the following equation:

$$\text{Well volume} = nr^2h(cf) \quad \text{[Equation 1]}$$

where:

- $n$ = pi
- $r$ = radius of monitoring well (feet)
- $h$ = height of the water column (feet) [This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]
- $cf$ = conversion factor (gal/ft$^3$) = 7.48 gal/ft$^3$ [In this equation, 7.48 gal/ft$^3$ is the necessary conversion factor, because 7.48 gallons of water occupy 1 ft$^3$]

Monitoring wells are typically 2 inches, 3 inches, 4 inches, or 6 inches in diameter. If the diameter of the monitoring well is known, a number of standard conversion factors can be used to simplify the equation above.

The volume, in gallons per linear foot, for various standard monitoring well diameters can be calculated as follows:

$$v = nr^2(cf) \quad \text{[Equation 2]}$$

where:

- $v$ = volume in gallons per linear foot
- $n$ = pi
- $r$ = radius of monitoring well (feet)
- $cf$ = conversion factor (7.48 gal/ft$^3$)

For a 2-inch diameter well, the volume per linear foot can be calculated as follows:

$$v = nr^2(cf) \quad \text{[Equation 2]}$$
$$= 3.14\ (1/12\ \text{ft})^2\ 7.48\ \text{gal/ft}^3$$
$$= 0.1632\ \text{gal/ft}$$

Remember that if you have a 2-inch diameter well, you must convert this to the radius in feet to be able to use the equation.

The volume per linear foot for monitoring wells of common size are as follows:

| Well diameter | v (volume in gal/ft.) |
|---|---|
| 2-inch | 0.1632 |
| 3-inch | 0.3672 |
| 4-inch | 0.6528 |
| 6-inch | 1.4688 |

If you utilize the factors above, Equation 1 should be modified as follows:

$$\text{Well volume} = h(v) \quad \text{[Equation 3]}$$

where:

- $h$ = height of water column (feet)
- $v$ = volume in gallons per linear foot from Equation 2

## 6.9 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

- All data must be documented on standard chain of custody forms, field data sheets or personal/site logbooks.

- All instrumentation must be operated in accordance with operating instructions as

# ATTACHMENT E

## SAMPLING EQUIPMENT DECONTAMINATION
## EPA/ERT SOP #2006

# 1.0 SAMPLING EQUIPMENT DECONTAMINATION: SOP #2006

## 1.1 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes methods used for preventing or reducing cross-contamination, and provides general guidelines for sampling equipment decontamination procedures at a hazardous waste site. Preventing or minimizing cross-contamination in sampled media and in samples is important for preventing the introduction of error into sampling results and for protecting the health and safety of site personnel.

Removing or neutralizing contaminants that have accumulated on sampling equipment ensures protection of personnel from permeating substances, reduces or eliminates transfer of contaminants to clean areas, prevents the mixing of incompatible substances, and minimizes the likelihood of sample cross-contamination.

## 1.2 METHOD SUMMARY

Contaminants can be physically removed from equipment, or deactivated by sterilization or disinfection. Gross contamination of equipment requires physical decontamination, including abrasive and non-abrasive methods. These include the use of brushes, air and wet blasting, and high-pressure water cleaning, followed by a wash/rinse process using appropriate cleaning solutions. Use of a solvent rinse is required when organic contamination is present.

## 1.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this SOP.

## 1.4 INTERFERENCES AND POTENTIAL PROBLEMS

- The use of distilled/deionized water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment provided that it has been verified by laboratory analysis to be analyte free.

- An untreated potable water supply is not an acceptable substitute for tap water. Tap water may be used from any municipal water treatment system for mixing of decontamination solutions.

- Acids and solvents utilized in the decontamination sequence pose the health and safety risks of inhalation or skin contact, and raise shipping concerns of permeation or degradation.

- The site work plan must address disposal of the spent decontamination solutions.

- Several procedures can be established to minimize contact with waste and the potential for contamination. For example:

  - Stress work practices that minimize contact with hazardous substances.

  - Use remote sampling, handling, and container-opening techniques when appropriate.

  - Cover monitoring and sampling equipment with protective material to minimize contamination.

  - Use disposable outer garments and disposable sampling equipment when appropriate.

## 1.5 EQUIPMENT/APPARATUS

- appropriate personal protective clothing
- non-phosphate detergent
- selected solvents
- long-handled brushes
- drop cloths/plastic sheeting
- trash container
- paper towels
- galvanized tubs or buckets
- tap water

- High-Pressure Water: This method consists of a high-pressure pump, an operator-controlled directional nozzle, and a high pressure hose. Operating pressure usually ranges from 340 to 680 atmospheres (atm) which relates to flow rates of 20 to 140 liters per minute.

- Ultra-High-Pressure Water: This system produces a pressurized water jet (from 1,000 to 4,000 atm). The ultra-high-pressure spray removes tightly-adhered surface film. The water velocity ranges from 500 m/sec (1,000 atm) to 900 m/sec (4,000 atm). Additives can enhance the method. This method is not applicable for hand-held sampling equipment.

### *Disinfection/Rinse Methods*

- Disinfection: Disinfectants are a practical means of inactivating infectious agents.

- Sterilization: Standard sterilization methods involve heating the equipment. Sterilization is impractical for large equipment.

- Rinsing: Rinsing removes contaminants through dilution, physical attraction, and solubilization.

## 1.7.2 Field Sampling Equipment Cleaning Procedures

Solvent rinses are not necessarily required when organics are not a contaminant of concern and may be eliminated from the sequence specified below. Similarly, an acid rinse is not required if analysis does not include inorganics.

1. Where applicable, follow physical removal procedures specified in section 1.7.1.
2. Wash equipment with a non-phosphate detergent solution.
3. Rinse with tap water.
4. Rinse with distilled/deionized water.
5. Rinse with 10% nitric acid if the sample will be analyzed for trace ~~organics.~~* INORGANICS
6. Rinse with distilled/deionized water.
7. Use a solvent rinse (pesticide grade) if the sample will be analyzed for organics.
8. Air dry the equipment completely.
9. Rinse again with distilled/deionized water.

Selection of the solvent for use in the decontamination process is based on the contaminants present at the site. Use of a solvent is required when organic contamination is present on-site. Typical solvents used for removal of organic contaminants include acetone, hexane, or water. An acid rinse step is required if metals are present on-site. If a particular contaminant fraction is not present at the site, the nine-step decontamination procedure listed above may be modified for site specificity. The decontamination solvent used should not be among the contaminants of concern at the site.

Table 1 lists solvent rinses which may be required for elimination of particular chemicals. After each solvent rinse, the equipment should be air dried and rinsed with distilled/deionized water.

Sampling equipment that requires the use of plastic tubing should be disassembled and the tubing replaced with clean tubing, before commencement of sampling and between sampling locations.

## 1.8 CALCULATIONS

This section is not applicable to this SOP.

## 1.9 QUALITY ASSURANCE/ QUALITY CONTROL

One type of quality control sample specific to the field decontamination process is the rinsate blank. The rinsate blank provides information on the effectiveness of the decontamination process employed in the field. When used in conjunction with field blanks and trip blanks, a rinsate blank can detect contamination during sample handling, storage and sample transportation to the laboratory.

* TYPO AT TIME OF PRINTING

ATTACHMENT F

WELL DEVELOPMENT FORM

# GEOLIS Well Development Form

COMPANY: _____ WELL NO.: _____

CLIENT: _____ DATE: _____

PROJECT: _____ LOGGER: _____

SITE: _____ SIGNATURE: _____

ONE WELL VOLUME: _____ gallons WELL TD: _____ ft TOC

Well Volume (gallons/foot) 2-inch = 0.16 6-inch = 1.47 4-inch = 0.65 8-inch = 2.61

| TIME | ACTIVITY CODE | DEPTH TO WATER (ft) | PURGE RATE (gpm) | PURGE VOLUME (gal) | FIELD MEASUREMENTS | | | | | | | TURBIDITY | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | FINAL | | | | | | | | | | | | |

FINAL WELL YIELD: _____ GPM PUMP RATE - ESTIMATED CORRESPONDING DRAWDOWN: _____ FT

| DEVELOPMENT ACTIVITY CODES | | FIELD MEASUREMENT CODES | TURBIDITY |
|---|---|---|---|
| DBB = Begin Bailing | DBE = End Bailing | MTP = Temperature | Enter Turbidity Meter Reading (Final should be < 5 NTU) |
| DOB = Begin Overpumping | DOE = End Overpumping | MSC = Specific Conductance | OR |
| DRB = Begin Rawhiding | DRE = End Rawhiding | MPD = Photoionizer (e.g., HNu) | Enter Qualitative Observations |
| DCB = Begin Recirculation | DCE = End Recirculation | MFD = Flame Ionizer (e.g., OVA) | H = High - Opaque/Muddy/Silty |
| DHB = Begin Hydraulic Jetting | DHE = End Hydraulic Jetting | MDO = Dissolved Oxygen | M = Medium - Translucent/Cloudy |
| DAB = Begin Air Surging | DAE = End Air Surging | MPH = pH | L = Low - Transparent/Some Silt |
| DSB = Begin Surge Blocking | DSE = End Surge Blocking | MEH = Eh | N = None - Clear/No Visible Silt |
| DXB = Begin Other | DXE = End Other | MWC = Turbidity Cone | |
| Specify other codes here: | | MOH = Other: | |
| DMS = Field Measurements: Select from codes at right | | MOZ = Other: | |

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# ATTACHMENT G

# WELL CONSTRUCTION DETAILS

Dan Raviv Associates, Inc.

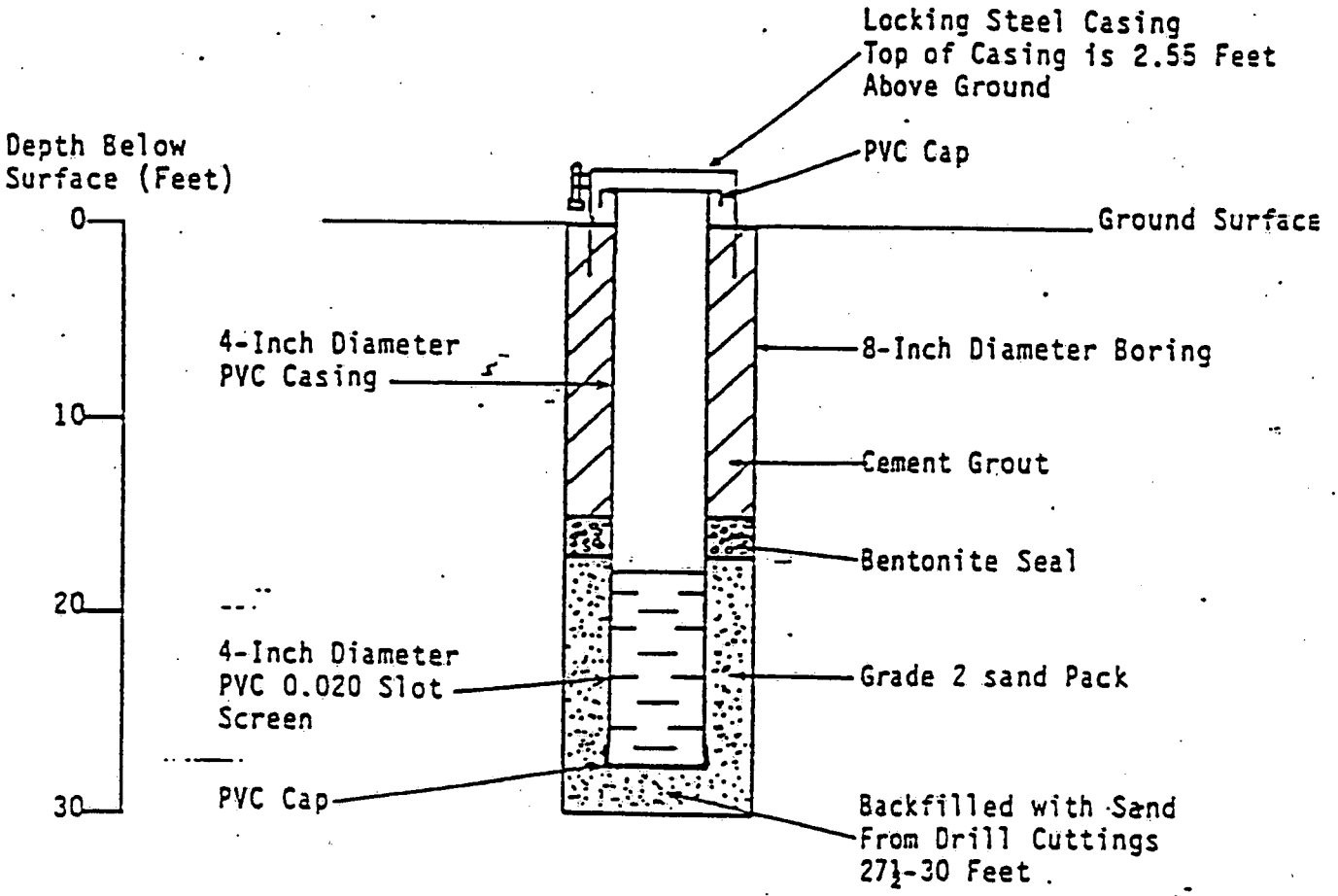


Job No. 84C182

PROJECT Bayonne Barrel and Drum Company SUBJECT Monitoring Wells

COMPUTATION Construction Details-RRDC1

COMPUTED BY _____ DATE 12/26/85 CHECKED BY _____ DATE _____




Total Depth Drilled 30 Feet
Total Depth Cased 27½ Feet

Dan Raviv Associates, Inc.

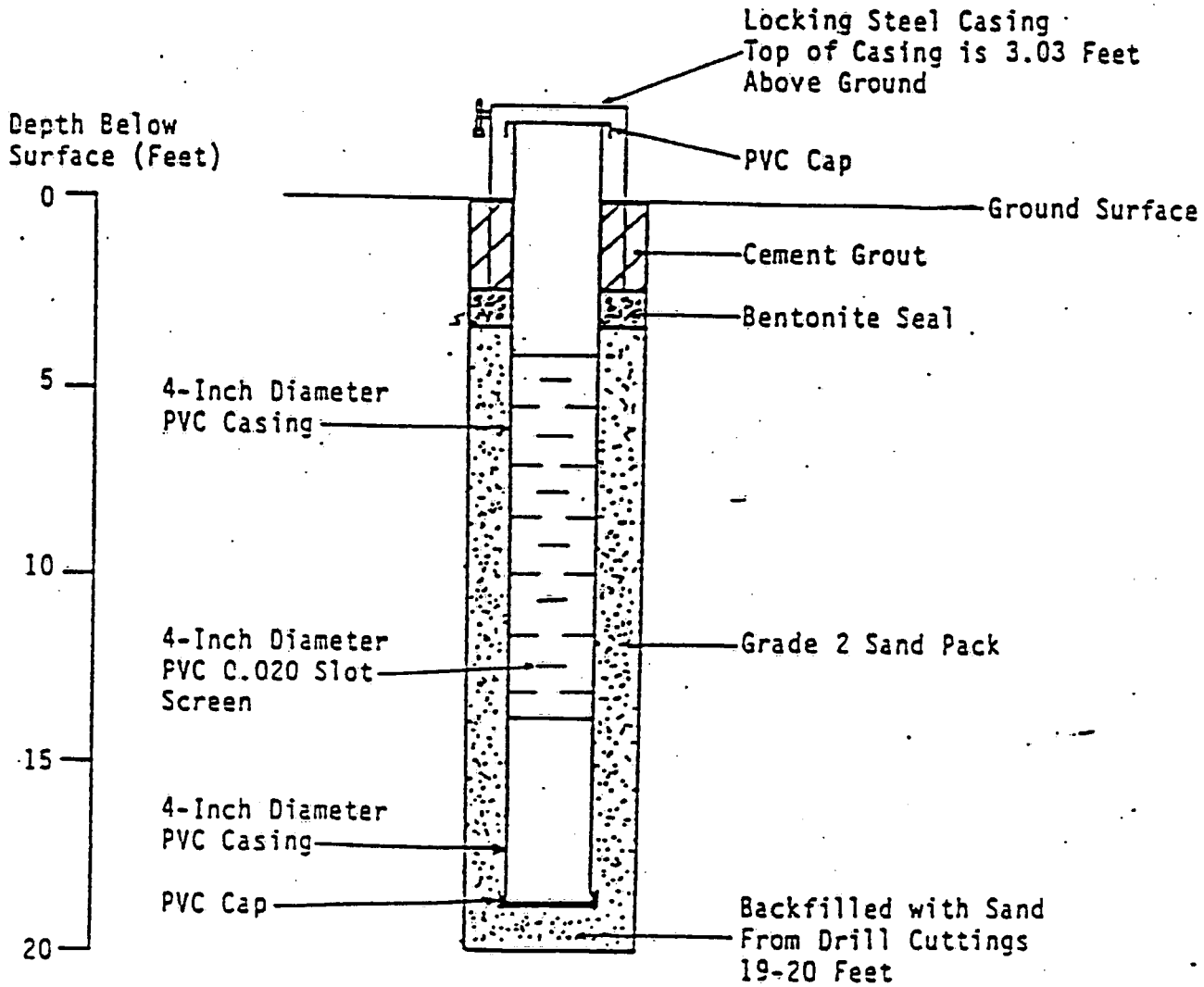


Job No. 84C182

PROJECT Bayonne Barrel and Drum Company SUBJECT Monitoring Wells

COMPUTATION Construction Details-BBDC2

COMPUTED BY _____ DATE 12/26/85 CHECKED BY _____ DATE _____




Total Depth Drilled 20 Feet
Total Depth Cased 19 Feet

Dan Raviv Associates, Inc.

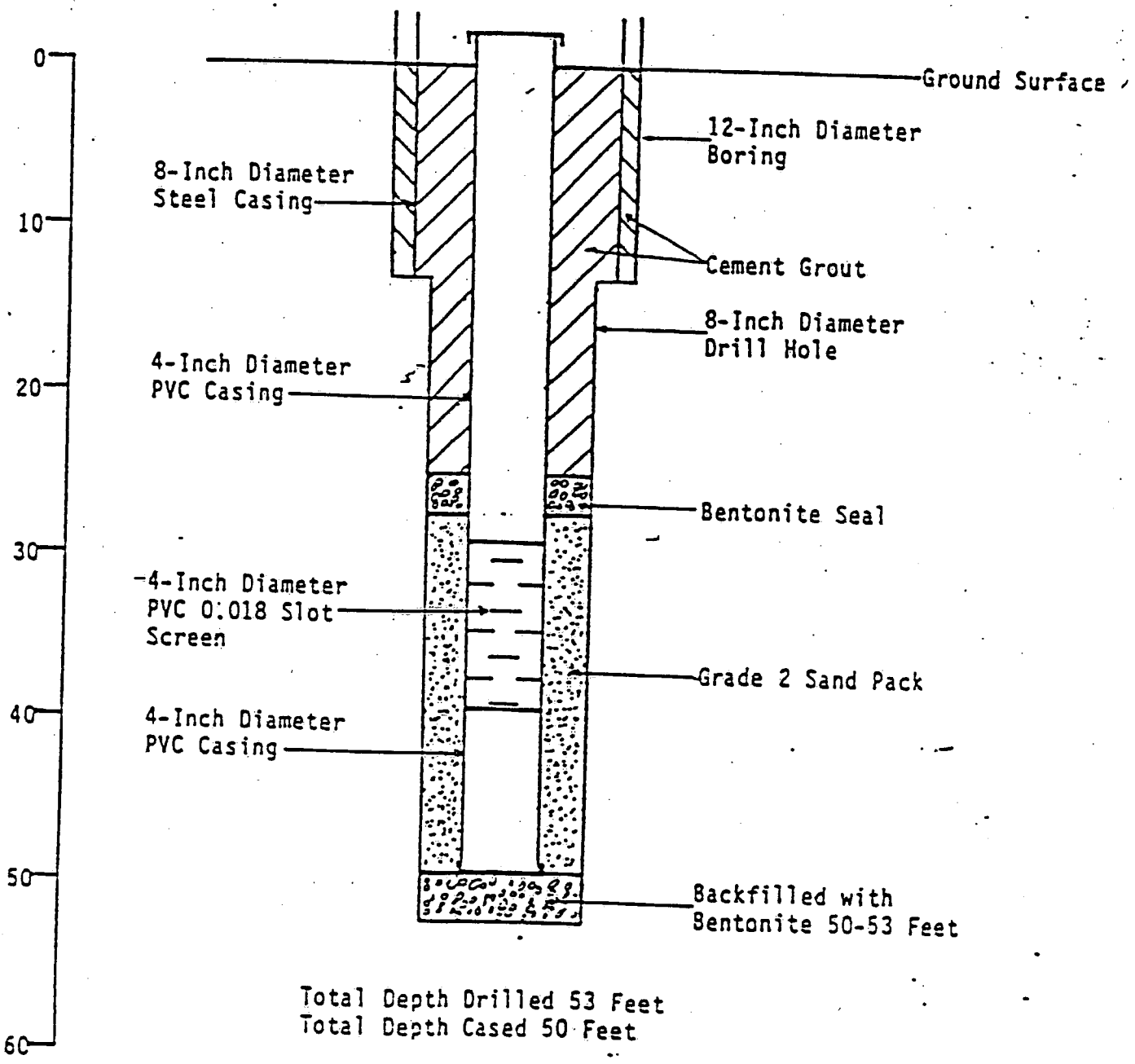


Job No. 84C182

PROJECT Bayonne Barrel and Drum Company SUBJECT Monitoring Wells

COMPUTATION Well Construction Details-8DC2

COMPUTED BY _____ DATE 12/26/85 CHECKED BY _____ DATE _____

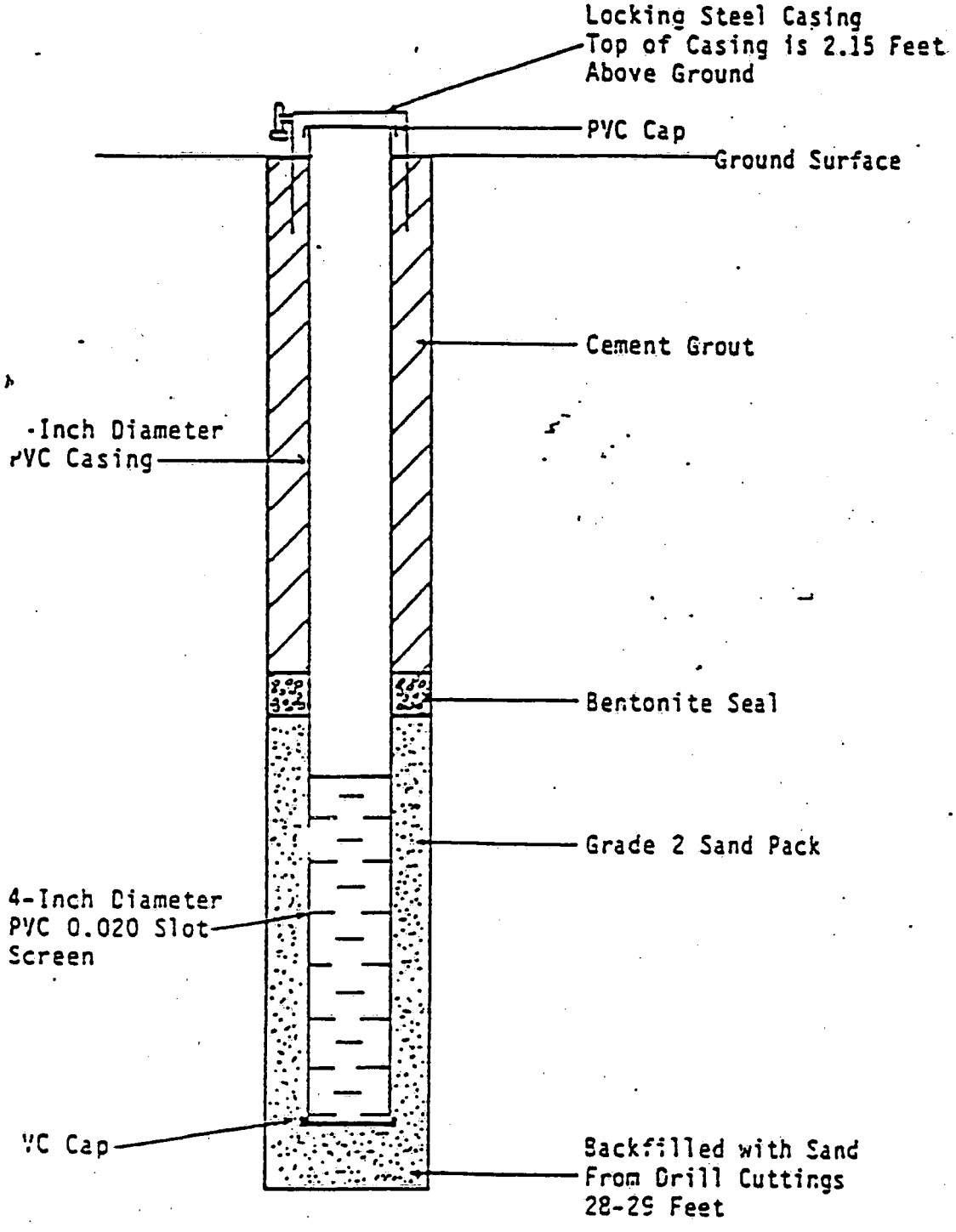



Total Depth Drilled 53 Feet
Total Depth Cased 50 Feet

ne Barrel and Drum Company SUBJECT Monitoring Wells

Construction Details-28DC4

DATE 12/26/85 CHECKED BY DATE




Total Depth Drilled 30 Feet
Total Depth Cased 28 Feet

Dan Raviv Associates, Inc.

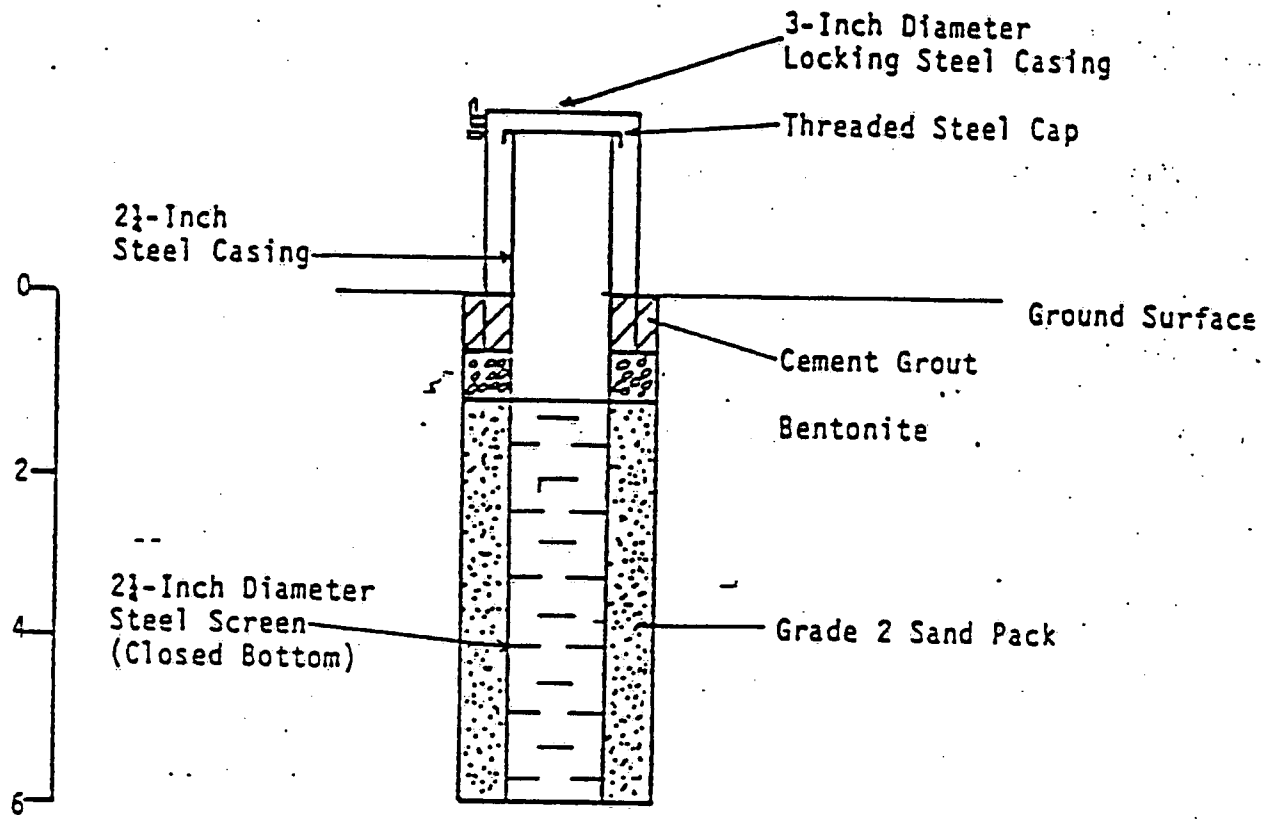


Job No. 84C182

PROJECT Bayonne Barrel and Drum Company SUBJECT Monitoring Wells

COMPUTATION Well Construction Details-88DC5

COMPUTED BY _____ DATE 12/26/85 CHECKED BY _____ DATE _____




Total Depth Drilled 6 Feet
Total Depth Cased 6 Feet

E

DWR-138 M
12/91

New Jersey Department of Environmental Protection and Energy
Bureau of Water Allocation

# MONITORING WELL RECORD

Well Permit No 26 - 14837
Atlas Sheet Coordinates 26 : 231 : 16

OWNER IDENTIFICATION - Owner EDLE REALTY INC.
Address 200 ELM ST.
City DEDHAM State MA. Zip Code 02026

WELL LOCATION - If not the same as owner please give address. Owner's Well No. MW 27W
County ESSEX Municipality Newark Lot No. 12 Block No. 5002
Address 104 180 Foundry St.

TYPE OF WELL (as per Well Permit Categories) Monitoring Date well completed 12/21/88
Regulatory Program Requiring Well Case I.D. #
CONSULTING FIRM/FIELD SUPERVISOR (if applicable) Tele. #

WELL CONSTRUCTION
Total depth drilled 25 ft.
Well finished to 23 ft.
Borehole diameter:
Top 11 in.
Bottom 11 in.
Well was finished: [X] above grade [ ] flush mounted
If finished above grade, casing height (stick up) above land surface 2.5 ft.
Was steel protective casing installed? [X] Yes [ ] No

| | Depth to Top (ft.) [From land surface] | Depth to Bottom (ft.) | Diameter (inches) | Type and Material |
|---|---|---|---|---|
| Inner Casing | +2.5 | 11 | 4 | PVC |
| Outer Casing (Not Protective Casing) | NA | NA | NA | |
| Screen (Note slot size) | 11 | 21 | 4 | PVC .010 |
| Tail Piece | 21 | 23 | 4 | SUMP |
| Gravel Pack | 9 | 25 | #2 | Morrie |
| Annular Seal/Grout | 0 | 9 | Bentonite Pellets | Cement |
| Method of Grouting | TREMIE | | | |

Static water level after drilling 15.10 ft.
Water level was measured using WLI
Well was developed for 2.5 hours at 2 gpm
Method of development SUBMERSIBLE
Was permanent pumping equipment installed? [ ] Yes [X] No
Pump capacity NA gpm
Pump type: NA
Drilling Method HSA
Drilling Fluid NONE Type of Rig CME 75
Name of Driller Paul Keeney
Health and Safety Plan submitted? [X] Yes [ ] No
Level of Protection used on site (circle one) None (D) C B A
N.J. License No. 13495.
Name of Drilling Company Empire Soils

GEOLOGIC LOG (Copies of other geologic logs and/or geophysical logs should be attached.)

See Attached Log

I certify that I have drilled the above-referenced well in accordance with all well permit requirements and all applicable State rules and regulations.

Driller's Signature Paul Keeney Date 12-21-88

COPIES: White & Green - DEPE Canary - Driller Pink - Owner Goldenrod - Health Dept.

| DATE | TIME | DRILLED FROM | DRILLED TO | WEATHER | TEMP. |
|---|---|---|---|---|---|
| 12/21/88 | | | | | |

EMPIRE

FIELD LOG

HOLE NO. MW-27

GRD. ELEV. 2614837

26-221-16

PROJECT

LOCATION

Sheet ____ of ____

| DEPTH OF SAMPLE | SAMPLE NO | BLOWS ON SAMPLER 0/6 | 6/12 | 12/18 | N | BLOWS ON CASING C | MOISTURE | COLOR | SAMPLE RECOVERY | CLASSIFICATION OF MATERIALS DRILLED | OTHER DATA | WELL DETAILS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0-2 | 1 | 11 | 61 | | | | | | | Fine to coarse SAND and GRAVEL | | |
| | | | 38 | 38 | 99 | | | | | | | |
| 2-4 | 2 | 19 | 29 | | | | | | | | | |
| | | | 25 | 21 | 54 | | | | | " " | | |
| 4-6 | 3 | 2 | 5 | | | | | | | | | |
| | | | 6 | 3 | 11 | | | | | | | |
| 6-8 | 4 | 3 | 32 | | | | | | | | | |
| | | | 31 | 48 | 63 | | | | | | | |
| 8-10 | 5 | 17 | 100/4 | | | | | | | " " | | |
| 10-12 | 6 | 2 | 2 | | | | | | | | | |
| | | | 1 | 1 | 3 | | | | | | | |
| 12-14 | 7 | 1 | 4 | | | | | | | GRAVEL, cinders | | |
| | | | 5 | 5 | 9 | | | | | Fine to medium SAND, trace silt | | |
| 14-16 | 8 | 1 | 2 | | | | | | | | | |
| | | | 2 | 2 | 4 | | | | | | | |
| 19-21 | 9 | 3 | 17 | | | | | | | Fine to medium SAND, trace silt | | |
| | | | 20 | 21 | 37 | | | | | | | |
| 23-25 | 10 | 8 | 32 | | | | | | | | | |
| | | | 30 | 30 | 62 | | | | | | | |
| | | | | | | | | | | End of Boring at 25.0 feet | | |

NOTATION: SIZE AUGERS / CASING 6¼" SIZE SPOON ____

SIZE THIN-WALLED TUBE ____ SIZE CORE ____

N = NO. OF BLOWS TO DRIVE 2 "SPOON 12" WITH 140 LB. WEIGHT FALLING 30 PER BLOW

C = NO. OF BLOWS TO DRIVE "CASING" WITH LB. WEIGHT FALLING PER BLOW

FILL OUT BACK OF LOG AND SIGN YOUR NAME

# ATTACHMENT H

## NEW JERSEY GROUNDWATER QUALITY STANDARDS
## N.J.A.C. 7:9-6

# APPENDIX

TABLE 1
SPECIFIC GROUND WATER QUALITY CRITERIA—CLASS II–A AND PRACTICAL QUANTITATION LEVELS

| Constituent | CASRN | Ground Water Quality Criteria* | Practical Quantitation Levels (PQLs)* | Higher of PQLs and Ground Water Quality Criteria (µg/L)* |
|---|---|---|---|---|
| Acenaphthene | 83–32–9 | 400 | 10 | 400 |
| Acenapthylene | 208–96–8 | NA | 10 | NA |
| Acetone | 67–64–1 | 700 | NA | 700 |
| Acrolein | 107–02–8 | NA | 50 | NA |
| Acrylamide | 79–06–1 | 0.008 | NA | 0.008 |
| Acrylonitrile | 107–13–1 | 0.06 | 50 | 50 |
| Adipates (Di(ethylhexyl)adipate) | 103–23–1 | NA | 6 | NA |
| Alachlor | 15972–60–8 | 0.43 | 2 | 2 |
| Aldicarb sulfone | 1646–88–4 | 2 | 3 | 3 |
| Aldrin | 309–00–2 | 0.002 | 0.04 | 0.04 |
| Aluminum | 7429–90–5 | 200 | 200 | 200 |
| Ammonia | | 500 | 200 | 500 |
| Anthracene | 120–12–7 | 2,000 | 10 | 2,000 |
| Antimony | 7440–36–0 | 2 | 20 | 20 |
| Arsenic (Total) | 7440–38–2 | 0.02 | 8 | 8 |
| Asbestos | 1332–21–4 | 7 × 10⁶f/L>10um[a] | 10⁵f/L>10um[a] | 7 × 10⁶f/L>10um[a] |
| Atrazine | 1912–24–9 | 3 | 1 | 3 |
| Barium | 7440–39–3 | 2,000 | 200 | 2,000 |
| Benz(a)anthracene | 56–55–3 | NA | 10 | NA |
| Benzene | 71–43–2 | 0.2 | 1 | 1 |
| Benzidine | 92–87–5 | 0.0002 | 50 | 50 |
| Benzyl Alcohol | 100–51–6 | 2,000 | NA | 2,000 |
| Benzo(a)pyrene (BaP) | 50–32–8 | NA | 20 | NA |
| 3,4–Benzofluoranthene (Benzo(b)fluoranthene) | 205–99–2 | NA | 10 | NA |
| Benzo(ghi)perylene | 191–24–2 | NA | 20 | NA |
| Benzo(k)fluoranthene | 207–08–9 | NA | 2 | NA |
| Beryllium | 440–41–7 | 0.008 | 20 | 20 |
| alpha-BHC (alpha-HCH) | 319–84–6 | 0.006 | 0.02 | 0.02 |
| beta-BHC (beta-HCH) | 319–85–7 | 0.2 | 0.04 | 0.2 |
| gamma-BHC (gamma-HCH/Lindane) | 58–89–9 | 0.2 | 0.2 | 0.2 |
| Bis(2–chloroethyl) ether | 111–44–4 | 0.03 | 10 | 10 |
| Bis(2–chloroisopropyl) ether | 39638–32–9 | 300 | 10 | 300 |
| Bis(2–ethylhexyl) phthalate | 117–81–7 | 3 | 30 | 30 |
| Bromodichloromethane (Dichlorobromomethane) | 75–27–4 | 0.3 | 1 | 1 |
| Bromoform | 75–25–2 | 4 | 0.8 | 4 |
| Butylbenzyl phthalate | 85–68–7 | 100 | 20 | 100 |
| Cadmium | 7440–43–9 | 4 | 2 | 4 |
| Carbofuran | 1563–66–2 | 40 | 7 | 40 |
| Carbon tetrachloride | 56–23–5 | 0.4 | 2 | 2 |
| Chlorobenzene | 108–90–7 | 4 | 2 | 4 |
| Chlordane | 57–74–9 | 0.01 | 0.5 | 0.5 |
| Chloride | 16887–00–6 | 250,000 | 2,000 | 250,000 |
| Chloroform | 67–66–3 | 6 | 1 | 6 |
| 4–Chloro–3–methyl (o-chloro-m-cresol) | 59–50–7 | NA | 20 | NA |
| 2–Chlorophenol | 95–57–8 | 40 | 20 | 40 |
| Chlorpyrifos | 12921–88–2 | 20 | 0.2 | 20 |
| Chromium (Total) | 7440–47–3 | 100 | 10 | 100 |
| Chrysene | 218–01–9 | NA | 20 | NA |
| Color | | 10 CU | 20 CU | 20 CU |
| Copper | 7440–50–8 | 1,000 | 1,000 | 1,000 |
| Cyanide | 57–12–5 | 200 | 40 | 200 |
| 2,4–D | 94–75–7 | 70 | 5 | 70 |
| Dalapon | 75–99–0 | 200 | 10 | 200 |
| 4,4'–DDD (p,p'–TDE) | 72–54–8 | 0.1 | 0.04 | 0.1 |
| 4,4'–DDE | 72–55–9 | 0.1 | 0.04 | 0.1 |
| 4,4'–DDT | 50–29–3 | 0.1 | 0.06 | 0.1 |
| Demeton | 8065–48–3 | 0.3 | NA | 0.3 |
| Dibenz(a,h)anthracene | 53–70–3 | NA | 20 | NA |
| Dibromochloromethane (Chlorodibromomethane) | 124–48–1 | 10 | 1 | 10 |
| 1,2–Dibromo–3–chloropropane (DBCP) | 96–12–8 | NA | 2 | NA |
| Di-n-butyl phthalate | 84–74–2 | 900 | 20 | 900 |
| 1,2–Dichlorobenzene | 95–50–1 | 600 | 5 | 600 |
| 1,3–Dichlorobenzene | 541–73–1 | 600 | 5 | 600 |
| 1,4–Dichlorobenzene | 106–46–7 | 75 | 5 | 75 |
| 3,3'–Dichlorobenzidine | 91–94–1 | 0.08 | 60 | 60 |
| 1,1–Dichloroethane | 75–34–3 | 70 | NA | 70 |
| 1,2–Dichloroethane | 107–06–2 | 0.3 | 2 | 2 |
| 1,1–Dichloroethylene | 75–35–4 | 1 | 2 | 2 |
| cis–1,2–Dichloroethylene | 156–59–2 | 10 | 2 | 10 |
| trans–1,2–Dichloroethylene | 156–60–5 | 100 | 2 | 100 |
| 2,4–Dichlorophenol | 120–83–2 | 20 | 10 | 20 |
| 1,2–Dichloropropane | 78–87–5 | 0.5 | 1 | 1 |
| cis–1,3–Dichloropropene | 10061–01–5 | NA | 5 | NA |
| trans–1,3–Dichloropropene | 10061–02–6 | NA | 7 | NA |

| Constituent | CASRN | Ground Water Quality Criteria* | Practical Quantitation Levels (PQLs)* | Higher of PQLs and Ground Water Quality Criteria (µg/L)* |
|---|---|---|---|---|
| 1,[illegible]ichloropropene (cis and trans) | 542–75–6 | 0.2 | NA | .02 |
| [illegible]in | 60–57–1 | 0.002 | 0.03 | 0.03 |
| Di[illegible]yl phthalate | 84–66–2 | 5,000 | 10 | 5,000 |
| 2,4–Dimethylphenol | 105–67–9 | 100 | 20 | 100 |
| Dimethyl phthalate | 131–11–3 | NA | 10 | NA |
| 4,6–Dinitro–o–cresol | 534–52–1 | NA | 60 | NA |
| 2,4–Dinitrophenol | 51–28–5 | 10 | 40 | 40 |
| 2,4–Dinitrotoluene/2,6–Dinitrotoluene mixture | 121–14–2 | 0.05 | 10 | 10 |
| 2,6–Dinitrotoluene | 606–20–2 | NA | 10 | NA |
| Di–n–octyl phthalate | 117–84–0 | 100 | NA | 100 |
| Dinoseb | 88–85–7 | 7 | 2 | 7 |
| 1,2–Diphenylhydrazine | 122–66–7 | 0.04 | NA | 0.04 |
| Diquat | 85–00–7 | 20 | NA | 20 |
| Endosulfan | 115–29–7 | 0.4 | NA | 0.4 |
| alpha–Endosulfan (Endosulfan I) | 959–98–8 | 0.4 | 0.02 | 0.4 |
| beta–Endosulfan (Endosulfan II) | 3–213–65–9 | 0.4 | 0.04 | 0.4 |
| Endosulfan sulfate | 031–07–8 | 0.4 | 0.03 | 0.4 |
| Endothall | 145–73–3 | 100 | NA | 100 |
| Endrin | 72–20–8 | 2 | 0.04 | 2 |
| Epichlorohydrin | 106–89–8 | 4 | NA | 4 |
| Ethylbenzene | 100–41–4 | 700 | 5 | 700 |
| Ethylene dibromide | 106–93–4 | 0.0004 | 0.05 | 0.05 |
| Fluoranthene | 206–44–0 | 300 | 10 | 300 |
| Fluorene | 86–73–7 | 300 | 10 | 300 |
| Fluoride | 16984–48–8 | 2,000 | 500 | 2,000 |
| Foaming agents (ABS/LAS) | | 500 | 0.5 | 500 |
| Glyphosate | 071–83–6 | 700 | NA | 700 |
| Hardness (as $CaCO_3$) | | 250 mg/L | 10 mg/L | 250 mg/L |
| Heptachlor | 76–44–8 | 0.008 | 0.4 | 0.4 |
| Heptachlor epoxide | 024–57–3 | 0.004 | 0.2 | 0.2 |
| Hexachlorobenzene | 118–74–1 | 0.02 | 10 | 10 |
| Hexachlorobutadiene | 87–68–3 | 1 | 1 | 1 |
| Hexachlorocyclopentadiene | 77–47–4 | 50 | 10 | 50 |
| Hexachloroethane | 67–72–1 | 0.7 | 10 | 10 |
| Hydrogen sulfide | 7783–06–4 | 20 | NA | 20 |
| Indeno(1,2,3–cd)pyrene | 193–39–5 | NA | 20 | NA |
| Iron | 7439–89–6 | 300 | 100 | 300 |
| Isophorone | 78–59–1 | 100 | 10 | 100 |
| [illegible] (Total) | 7439–92–1 | 5 | 10 | 10 |
| [illegible]hion | 121–75–5 | 200 | 5 | 200 |
| Manganese | 7439–96–5 | 50 | 6 | 50 |
| Mercury (Total) | 7439–97–6 | 2 | 0.5 | 2 |
| Methoxychlor | 72–43–5 | 40 | 10 | 40 |
| Methyl bromide (bromomethane) | 74–83–9 | 10 | 2 | 10 |
| Methyl chloride (chloromethane) | 74–87–3 | 30 | 2 | 30 |
| Methyl ethyl ketone | 78–93–3 | 300 | NA | 300 |
| 3–Methyl–4–chlorophenol | 59–50–7 | NA | 20 | NA |
| Methylene chloride | 75–09–2 | 2 | 2 | 2 |
| 4–Methyl–2–pentanone | 108–10–1 | 400 | NA | 400 |
| Mirex | 2385–85–5 | 0.01 | NA | 0.01 |
| Nickel (Soluble salts) | 7440–02–0 | 100 | 10 | 100 |
| Nitrate (as N) | 14797–55–8 | 10,000 | 400 | 10,000 |
| Nitrate and Nitrite (as N) | | 10,000 | NA | 10,000 |
| Nitrite (as N) | 14797–65–0 | 1,000 | 400 | 1,000 |
| Nitrobenzene | 98–95–3 | 3 | 10 | 10 |
| N–Nitrosodimethylamine | 62–75–9 | 0.0007 | 20 | 20 |
| N–Nitrosodiphenylamine | 86–30–6 | 7 | 20 | 20 |
| N–Nitrosodi–n–propylamine | 621–64–7 | 0.005 | 20 | 20 |
| Odor | | 3b | NA | 3b |
| Oil & Grease and Petroleum Hydrocarbons (PHC) | | None Noticeable | NA | None Noticeable |
| Oxamyl | 23135–22–0 | 200 | 20 | 200 |
| PCBs (Polychlorinated biphenyls) | 1336–36–3 | 0.02 | 0.5 | 0.5 |
| Pentachlorophenol | 87–86–5 | 0.3 | 1 | 1 |
| pH | | 6.5–8.5 | NA | 6.5–8.5 |
| Phenanthrene | 85–01–8 | NA | 10 | NA |
| Phenol | 108–95–2 | 4,000 | 10 | 4,000 |
| Picloram | 1918–02–1 | 500 | 1 | 500 |
| Pyrene | 129–00–0 | 200 | 20 | 200 |
| Selenium (Total) | 7782–49–2 | 50 | 10 | 50 |
| Silver | 7440–22–4 | NA | 2 | NA |
| Simazine | 122–34–9 | 1 | 0.8 | 1 |
| Sodium | 7440–23–5 | 50,000 | 400 | 50,000 |
| Styrene | 100–42–5 | 100 | 5 | 100 |
| Sulfate | 14808–79–8 | 250,000 | 5,000 | 250,000 |
| Taste | | None Objectionable | NA | None Objectionable |
| TCDD (2,3,7,8–Tetrachlorodibenzo–p–dioxin) | 1746–01–6 | 0.0000002 | 0.01 | 0.01 |
| [illegible],2–Tetrachloroethane | 630–20–6 | 10 | NA | 10 |
| [illegible]2–Tetrachloroethane | 79–34–5 | 2 | 1 | 2 |
| [illegible]achloroethylene | 127–18–4 | 0.4 | 1 | 1 |
| 2,3,4,6–Tetrachlorophenol | 58–90–2 | NA | 10 | NA |

| Constituent | CASRN | Ground Water Quality Criteria* | Practical Quantitation Levels (PQLs)* | Higher of PQLs and Ground Water Quality Criteria (µg/L)* |
|---|---|---|---|---|
| Thallium | 7440–28–0 | 0.5 | 10 | 10 |
| Toluene | 108–88–3 | 1,000 | 5 | 1,000 |
| Total dissolved solids (TDS) | | 500,000 | 10,000 | 500,000 |
| Toxaphene | 8001–35–2 | 0.03 | 3 | 3 |
| 2,4,5–TP | 93–72–1 | 50 | 5 | 50 |
| 1,2,4–Trichlorobenzene | 120–82–1 | 9 | 1 | 9 |
| 1,1,1–Trichloroethane | 71–55–6 | 30 | 1 | 30 |
| 1,1,2–Trichloroethane | 79–00–5 | 3 | 2 | 3 |
| Trichloroethylene | 79–01–6 | 1 | 1 | 1 |
| 2,4,5–Trichlorophenol | 95–95–4 | 700 | 10 | 700 |
| 2,5,6–Trichlorophenol | 88–06–2 | 3 | 20 | 20 |
| Vinylchloride | 75–01–4 | 0.08 | 5 | 5 |
| Xylenes (Total) | 1330–20–7 | 40 | 2 | 40 |
| m & p-Xylenes | NA | NA | 2 | NA |
| o-Xylene | NA | NA | 1 | NA |
| Zinc | 7440–66–6 | 5,000 | 30 | 5,000 |
| Microbiological criteria[m], Radionuclides & Turbidity | Prevailing Safe Drinking Water Act Regulations (N.J.A.C. 7:10–1 et seq.) | | | |

Explanation of Terms:

* = Ground Water Quality Criteria and PQLs are expressed as µg/L unless otherwise noted. Table 1 criteria are all maximum values unless clearly indicated as a range for which the minimum value is to the left and the maximum value is to the right.

PQL—Practical Quantitation Level as defined in N.J.A.C. 7:9–6.4

CASRN—Chemical Abstracts System Registration Number

NA = not available for this constituent

a = Asbestos criterion is measured in terms of fibers/L longer than 10 micrometers (f/L>10 um)

µg = micrograms, L = liter, f = fibers, CU = Standard Cobalt Units

b = Odor Threshold Number, mg = milligrams, H = Hardness

(Total) means the concentration of metal in an unfiltered sample following treatment with hot dilute mineral acid (as defined in "Methods for Chemical Analysis of Water & Wastes", EPA–600/4–79–020, March 1979) or other digestion defined by the analytical method. However samples that contain less than 1 nephlometric turbidity unit (NTU) and are properly preserved, may be directly analyzed without digestion.

m = Pursuant to prevailing Safe Drinking Water Act Regulations any positive result for fecal coliform is in violation of the MCL and is therefore an exceedance of the ground water quality criteria.

TABLE 2
INTERIM GENERIC GROUND WATER QUALITY CRITERIA

Interim Generic Criteria—Synthetic Organic Chemicals (SOC)*

| Constituent | Water Quality Criteria |
|---|---|
| SOCs with evidence of carcinogenicity lacking specific or interim specific criteria | 5 µg/l each<br>25 µg/l total |
| SOCs lacking evidence of carcinogenicity lacking specific or interim specific criteria | 100 µg/l each<br>500 µg/l total |

* SOCs are identified as having "evidence of carcinogenicity" or "lacking evidence of carcinogenicity" based upon available scientific evidence. Chemicals are classified as carcinogens or noncarcinogens for the purposes of risk assessment according to the weight of evidence utilized by USEPA in the National Primary Drinking Water Regulations (50 FR 46880–46901 (1985)).

Administrative corrections.
See: 25 N.J.R. 1552(a).
Petition for Rulemaking.
See: 27 N.J.R. 244(b).